MODE-CHOICE IN MALAYA: BEHAVIOURAL ASPECTS OF INTER-CITY PASSENGER TRANSPORT

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D. C. Johnston

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Abstract

Three major objectives were established for this study of mode-choice decisions affecting inter-city travel. They were: (1) the collection of basic information on mode-choice decisions, (2) an examination of the common belief that individuals with similar characteristics reveal similar attitudes, perceptions and decision-making processes, and (3) the development and testing of an integrated model of individual decision behaviour to see if mode-choice decisions could be reproduced from measurements of mode images.

Data were collected in Malaya during 1970 by means of two questionnaire surveys. One set of questionnaires was distributed to travellers making inter-city journeys and sought information on their awareness of alternative modes of transport and on the criteria used to evaluate them. The second survey was conducted among informal groups of respondents and used a semantic differential to measure images held of modes of transport. Data were also collected on the relative importance that respondents associated with particular mode attributes and their mode preferences for a specified journey.

Analyses of these data showed that: (1) fewer than half of the travellers were fully aware of the objective choice context, (2) travellers used a wide range of criteria to evaluate modes but concentrated mainly on matters of safety, cost and travel time, (3) the semantic differential generated summary mode images that were distinct one from another and highlighted major points of perceived similarity and contrast

between modes, (4) the knowledge that travellers held of the cost, duration and distance of their journeys was often highly inaccurate and (5) the tested aspects of the mode-choice decision were not strongly related to the characteristics of respondents. Several simple numerical models were used in attempts to reproduce the mode preferences reported by each respondent from the measurements made of his or her mode images. These models showed that more than forty percent of the decisions could be correctly predicted.
A critical review of the conceptual framework and operational procedures used in this study examined their relevance for research in behavioural geography.

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Conventions

Orthography

The system of spelling adopted in this study for Malaysian names has been taken from the map:

Directorate of National Mapping Malaysia (1968), Malaysia Barat (West Malaysia) 1968, (Scale 1:760,000)

Currency

Unless otherwise stated all currency is in Malaysian dollars. At the time of this survey (1970) M$1.00 = US$0.33 = NZ$0.29.

Distance

Imperial measures of distance were normally used in Malaysia during 1970 and so they, along with corresponding compound units of miles-per-hour and cents-per-mile, have been retained in this study (one mile = 1.61 kilometres).

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CHAPTER ONE: INTRODUCTION

This thesis reports on an investigation into the structure of the patterns of inter-city passenger transport in Malaya.[1] It is concerned primarily with seeking an explanation of the nature of these patterns in terms of the travel decisions made by persons who undertook inter-city journeys during 1970: that is, with the decisions that generated the pattern of mode use.[2] Three major objectives can be enumerated. The first is the collection of basic information on the mode-choice decision and the evaluation of its relevance for the understanding of transport patterns. Second, this study examines the oft repeated assertion that individuals with similar characteristics reveal similar attitudes, perceptions and decision-making processes. The third and most important objective is the development and testing of an integrated model of individual decision behaviour. Such an explicit concern with perception and decision-making clearly places this study within the realm of the "behavioural approach" to human geography. A brief definition of this approach is given and discussion then focusses on an amplification of the objectives listed above.

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1. For the purposes of this study Malaya is defined as the 11 States of Malaya (West or Peninsular Malaysia) and the Republic of Singapore.
2. It is necessary, here, to distinguish between the decisions of government agencies and private enterprise to provide the physical facilities for passenger transport and the decisions by travellers to make use of those facilities (Rimmer, 1974). Our present concern is solely with the latter set of decisions.

1.1 The "Behavioural Approach" in Human Geography

There can be little doubt that the "behavioural approach" has come to be widely accepted and practised in human geography. Several review papers record the wide range of studies conducted under this rubric and comment on the most promising lines for further work (Downs, 1968; Bordessa, 1969; Brookfield, 1969; Doherty, 1969; Saarinen, 1969; Downs, 1970b; Wood, 1970; Goodey, 1971; Golledge, Brown and Williamson, 1972; Walmsley and Day, 1972; Pocock, 1974; Saarinen, 1974). Relevant studies from a variety of disciplines as well as geography have been assembled into texts of collected readings (Lowenthal, 1967; Cox and Golledge, 1969; Downs and Stea, 1973; Ittleson, 1973) and geographers have produced monographs on theoretical or empirical themes (Saarinen, 1966; Pred, 1967, 1969). Within this literature there are signs of at least two divergent themes. One concentrates on the spatial structure of behaviour patterns while the second deals with processes that underly the structure. The present study comes squarely under the latter theme and defines the "behavioural approach" as

> "the attempt to understand, explain or predict a particular spatial pattern in terms of the perceptions, cognitions, preferences and/or decisions of the individual decision-making units whose

> behaviour contributed to the formation of that pattern"[1,2]

This explicit focus on actual decision processes excludes a variety of so called "behavioural" studies which, though dealing with individual or group behaviour, are oriented primarily to the description of patterns rather than to the processes which generated the patterns.

There are three main types of such studies:

(1) "cognitions" and "decisions" that contributed to some aggregate spatial pattern are identified by inference from the "residuals" obtained by comparing the actual pattern with the pattern derived from a particular normative model (Rushton, 1969, 1971; Hagerstrand, 1967),

(2) "pseudo-behavioural" studies where the researcher's own operational definition of a particular variable, without direct reference to the actors themselves, is labelled "perception", "attitude" or preference (Taylor, 1973, on "perceived distance"; Brown and

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1. The distinction between perception and cognition should be noted. Recent work in geography has adopted the convention, derived from experimental psychology, that perception is the "awareness of stimuli through the physiological excitation of sensory receptors... that occurs because of the presence of an object and that results in the immediate apprehension of that object by one or more of the senses" (Downs and Stea, 1973, p.13). Cognition, which includes "all of the modes of knowing (perceiving, thinking, imagining, reasoning, judging and remembering), would seem to include perception" (Hart and Moore, 1973, p.249). In the present study the terms "knowledge", "belief" and "image" are taken to be synonymous with this definition of "cognition".
2. Although the study of decision-making groups or organisations raises major methodological problems there is no good conceptual reason for restricting this definition to individual human actors and excluding from consideration households, business organisations, government departments and any other more or less coherent decision-making unit.

Longbrake, 1970, on "place utility" and Leopold, 1969, on "landscape aesthetics") and

(3) statistical models (especially multiple regression) that "explain" behavioural patterns in terms of objective measurements of the characteristics of decision-makers or the decision environment (Greenwood, 1970; Quandt and Baumol, 1966).

Even with these exclusions it is necessary to make explicit the point that is really only implicit in the above definition: the behavioural approach can only handle purposive behaviour mediated by conscious decision-making processes. Habitual, unthinking or unconscious behaviour could well play a role in shaping geographic patterns but they present severe research problems of their own that geographers are rarely equipped to handle.[1] The behavioural approach as defined here, therefore, deals with situations where the decision-making unit (individual actor or group of actors) is aware of a stimulus to behave in some manner, has to examine various courses of action and to select one to be put into operation. It is within this definition of the "behavioural approach" that the present study lies.

In its focus on the empirical study of cognitions and decisions influencing man's actions in space, the behavioural approach clearly has the potential to make a major contribution in the contemporary research thrust toward both the development of basic geographic theory and the solution of real world problems. Yet amidst the

1. See Tuan (1975) for some examples of these types of behaviour.

proliferation of studies investigating cognitions and decisions there is an occasional voice raised in criticism of the behavioural approach as practised by geographers. Some question the validity and reliability of methods used to measure images, attitudes or preferences (Brookfield, 1969; Harvey, 1969; Pocock, 1974); others query the representativeness of respondents studied (Goodey, 1971; Rieser, 1972; Herbert, 1973; Pocock, 1974). Much more basic is the question of whether the behavioural approach is really doing the job that is claimed for it. Brookfield, for example, comments

> "In all this work, descriptive and analytical, the mutual inter-relation of real environment, perceived environment and human activity emerges only in a shadowy, or at best, halting manner... While the significance of perception emerges equally positively from quantified and non-quantified research, the manner in which the system operates fails to emerge sharply except in quite restricted contexts."

and also

> "... decision makers operating within an environment base their decisions on the environment as they perceive it, not as it is. We have to come to terms with this fact. But to do so in conceptual terms is one thing; to find ways of incorporating the environment as perceived into our whole evolving empirical method is a problem of quite another order."
> (Brookfield, 1969, pp.61 and 76)

Berry puts the problem concisely

> "Behavioural geographers were calling for, but not producing, new types of theory."
> (Berry, 1973, p.3)

Examination of the literature bears out these comments.[1] There are many studies that deal with man's cognition of the environment and a large number that deal

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1. Similar points have been made by Rushton et al, 1971; Doddridge, 1972; Herbert, 1973; and Burnett, 1975.

with decisions affecting geographic patterns but rarely are the direct links between these two aspects explicitly examined in a single study. Often a researcher seems to assume that the image held of a particular spatial situation automatically defines how an individual will react in that situation. It has been suggested, for example, that

> "If individuals have a perception of the relative locations of both familiar and relatively unknown places, and can report them, then it should be possible to construct a map of the perceived locations of phenomena, and by comparison with actual locations, to assess the probable effects of any perceptual distortions on urban behavior."

and

> "Interaction distances that are overestimated should reduce the probability of interaction between points."
> (Golledge et. al. 1969, pp.60 and 63)

It does seem self-evident, even axiomatic, that man behaves according to what he sees and believes rather than what is. There are, however, some hints in the literature that the connection between an individual's image of a given environment and his behaviour in that environment is not just a simple and direct relationship. A particular image does not necessarily define a particular behaviour: two persons with identical knowledge of a given decision situation need not have identical behaviours in that situation. D. C. Johnston (1971), for example, pointed out that assessments of residential desirability are based on two things: the images held of places <u>and</u> the personal sets of criteria as to what constitutes a desirable living place.[1] Isard (1956) suggested "space preference" as an

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1. See also Jackson and R.J. Johnston (1972), R.J. Johnston (1974).

intervening variable between knowledge and behaviour in much the same way as Sonnenfeld (1969, 1974) viewed "environmental personality".

There is considerable interest in the study of environmental images in their own right but if the behavioural approach is to make any contribution at all to the understanding or explanation of spatial behaviour then it is essential that the relationships between cognition and behaviour be made explicit.[1] As long as that link is taken as a given rather than as an hypothesis then there can be no certainty that the measured images are even relevant for the explanation of observed behaviour. Until the connection is made explicit there must be doubts about the validity of the methods used to measure cognition. The methodology might generate data that seem (to the researcher) to index meaningful aspects of the environment under consideration. Most respondents will attempt to give some sort of believable answer to every question asked (Downs, 1968, p.6). But usually there is no hard evidence that images or attitudes as measured have any direct connection with behaviours assumed to spring from them. Pocock, for example, argues that

> "... respondents are challenged to rationalise a situation which previously may have lain in an unorganised, dormant, even subliminal, state. It is therefore not so much the image as the latent or potential image that is elicited by lengthy introspection and presented in perception exercises."
> (Pocock, 1974, p.8)

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1. Cadwallader (1975) stresses the same point.

Furthermore Tuan (1968), O'Riordan (1973) and Kirkby (1974) present examples of behaviour contradictory to expressed attitudes and images.[1] A particular research design might provide information on images held of, for example, a set of shopping centres. But unless it can be shown that the centre with the "best" image (however "best" might be defined) was the one actually patronised by the respondent there must still be doubt as to whether the image measurements are really meaningful inputs to an explanation of shopping behaviour.[2]

Very few behavioural studies have attempted to validate their methodology by making the link between cognition and behaviour explicit despite reminders of the need to do so.[3] Most studies concentrate on separate aspects of either cognition, preference or decision-making. The remainder of this chapter is concerned, therefore, with a brief

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1. Wicker reviewed a wide variety of studies in psychology and sociology that examined the relationship between attitudes and behaviour and concluded

   > "Taken as a whole, these studies suggest that it is considerably more likely that attitudes will be unrelated or only slightly related to overt behaviors than that attitudes will be closely related to actions." (Wicker, 1969, p.65)

2. L. Hudson (1972) conducted a study to investigate the influence of measured "shopping centre utility" on respondents' patronage of two shopping centres. Forty percent of the respondents whose "total shopping centre utility" favoured one centre shopped, in fact, at the other one. Hudson explained the discrepancy in terms of easier access to the centre actually selected. The "utility" measurements used did not include any reference to "transport costs" or "travel convenience".
3. Nash and Hille, 1968; Stea, 1969; Downs, 1970a; Harrison and Sarre, 1971; Menchik, 1972; and Svart, 1974 have pointed out that pencil and paper measures of mental processes need to be validated against observed behaviour.

examination of those studies in the available literature that do make use of an empirical model to integrate cognition with some form of behaviour.

1.2 Linking Cognition and Behaviour

There is no shortage of conceptual models that purport to identify the various mental processes that govern the behaviour of man in a given environment.[1] Few of the studies that did put forward such models, however, made any serious attempt to give their framework an operational definition. This section reviews the relatively small number of attempts that have been made to model or predict behaviour from empirical measurements of cognitions relevant to that behaviour. Before discussing the various studies in any detail it is useful to identify the basic types of model that have been used to link cognitions and behaviour. Two elements can be used to distinguish the main types: (a) the kind of behaviour that is modelled and (b) the level of aggregation at which the model is focussed. First, the behaviour that particular models deal with does not always consist of overt actions in space. Often the researcher has to rely upon a respondent's report of the decision he would make in a given hypothetical decision situation as the "behaviour" to be reproduced from

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1. See, for example, Huff (1960), Berkhofer (1969), Kolasa (1969), Peterson and Neumann (1969), Found (1971), Rees (1971), Kates (1971) and Pocock (1974). It should be noted that studies from the well developed field of statistical decision theory are not considered here. The present concern is with models that seek to explain or predict how people do behave and not with models that prescribe how people should behave.

measured cognitions. It is not always possible to be certain that the course of action selected in these circumstances would be implemented in a comparable real-life situation.[1] Findings from such studies can have, therefore, only limited applicability for the explanation of real world patterns. Nevertheless this type of operational definition for "behaviour" has been widely used and so the distinction between "overt" and "hypothetical" behaviour is retained for this classification.[2] Second, the model used to link cognition and behaviour can be focussed on either the aggregate or the individual level. Models operating at the aggregate level usually provide a single index of model performance for the study group as a whole. Two basic procedures have been used. The first involves the comparison of summary measures of cognition obtained from the group with some gross measure of behaviour. The second calculates a correlation coefficient, over all respondents, to summarise the relationship between individual measurements of cognition and behaviour. Models operating at the individual level, on the other hand, focus on the degree of success achieved by the model in predicting or reproducing the behaviour of each respondent. These individual assessments might also be averaged to give an overall measure of model performance.

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1. Sometimes the decision-maker might choose, because of inaccurate knowledge, an alternative that does not exist or is physically inaccessible. In other cases the decision or preference statement might really represent "wishful thinking" that, because of the decision-maker's social position, could not be implemented (Eyles, 1971).
2. It is assumed, of course, that verbal reports of actual past behaviour provide an accurate definition of "overt" behaviour.

Various empirical models that have linked cognition and behaviour have been classified according to these two criteria: the definition of behaviour and the level of operation (Table 1.1).[1] A brief discussion of the salient features of these different types of models starts with those that operate at the aggregate level.

1.2.1 Cognition - Behaviour Models: Aggregate Level

A wide range in subject matter is revealed by the aggregate level studies listed in Table 1.1. Michaels (1966), Wachs (1967) and Brancher (1972) dealt with route choice, Gould (1969) and S.E. White (1974) investigated residential desirability at the regional level while Whipple and Niedell (1970), Margulis (1972) and Cadwallader (1975) examined shopping behaviour. Methodology also varied considerably. MacDonald and MacDonald (1968) compared the distribution of "problems facing your hometown" given by "stayers" with the distribution of reasons explaining "why did you leave your home town" supplied by "movers". Both Whipple and Niedell (1970) and S.E. White (1974) had respondents rank a set of stimuli whereas R.J. Johnston (1971a, 1972), Margulis (1972) and Clark and Cadwallader (1973) used rating scales to obtain numerical

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1. Some of the studies referenced here did not deliberately set out to examine the nature of the link between cognition and behaviour. In these cases the connection emerged in the course of attaining another objective and was not the subject of direct discussion. This situation only emphasises the point made earlier that researchers have tended to assume a direct relationship between cognition and behaviour without making any attempt to formulate or test the nature of the link.

TABLE 1.1 Cognition-Behaviour Models: A Classification

Level of Operation	Definition of Behaviour[a] Overt	Hypothetical
Aggregate	Michaels, 1966 Saarinen, 1966 Wachs, 1967 MacDonald and MacDonald, 1968 Whipple and Niedell, 1970 Lundeen, 1972 Margulis, 1972 Menchik, 1972 S.E. White, 1974 Cadwallader, 1975	Michaels, 1966 Gould, 1969 Demko and Briggs, 1970 R.J. Johnston, 1971a, 1972 Brancher, 1972 Clark and Cadwallader, 1973 Ericksen, 1974 Sonnenfeld, 1974 Clark, 1975
Individual	Fox, 1965 L. Hudson, 1972 R. Hudson, 1972 Mackay et. al., 1975	Hansen, 1969, 1972

a. "Overt" behaviour refers to actual behaviour in space. "Hypothetical" behaviour is defined by the respondent's report of what his decision would be in a given hypothetical decision situation.

measures of cognitions. Brancher (1972) showed that cognitions, measured by content analyses of unstructured interviews, were consistent with verbal expressions of preference. Clark and Cadwallader (1973) correlated ratings of satisfaction with house and neighbourhood with ratings of the "desire to move". Criteria, reported to be important in the decision on a place to live, were related, by Menchik (1972), to objective physical measurements of each respondent's residential site.

Despite variations in subject matter and methodology, most of the studies listed indicate that it is possible to establish some degree of direct relationship between cognition and behaviour. This finding, though encouraging, is not entirely satisfactory. The models used were, in general, rather crude and in some cases amounted to little more than showing that measured cognitions of the behaviour selected were, overall, favourable to that behaviour.[1] Only Cadwallader (1975) explicitly modelled a decision among several alternative courses of action. The correlation exercises simply related single cognition variables to a measure of the behaviour that resulted from individual decision processes. Again the procedure dealt only with cognitions of the chosen alternative rather than with the cognitions of several alternatives that led to one being selected for action. Most important of all, the focus on aggregate models violates the spirit of the

1. Hansen (1972, p.208) raises the important problem of deciding whether the cognition generated the behaviour or the behaviour moulded the cognition.

behavioural approach. A particular aggregate level study might show that, over a sample of respondents, an increasingly favourable cognition was related to an increasing "intensity" of behaviour. Such a finding, however, says nothing about the actual influence of individual cognitions on individual behaviour.

1.2.2 Cognition - Behaviour Models: Individual Level

The modelling of individual behaviour from measurements of individual cognitions implies the consideration of more than one alternative and the selection, by some specified mechanism, of the "best" one to be implemented as behaviour. Many studies have investigated aspects of cognitions or choice behaviour but very few have been located that actually worked through the whole sequence of measuring cognitions, employing a selection mechanism to define a predicted choice for each individual and then matching the predictions against observed behaviour.[1] The five studies to be reviewed include only one dealing with verbal behaviour (Hansen, 1969, 1972) and three from the geographic literature (L. Hudson, 1972; R. Hudson, 1972; Mackay et. al, 1975). A fifth study (Fox, 1965) mixed both cognition variables and objective measures of the decision environment in the modelling process and so, strictly

1. Some studies apparently had the data required for this procedure but either worked at the aggregate level (Burnett, 1973, 1974; Cadwallader, 1975) or did not attempt to match predictions with observed behaviour (Sommers, 1969, 1970, 1971; Sommers and Jeng, 1970; Sommers and Leimkuhler, 1969).

speaking, does not fully meet the requirements of the other models considered here. It was felt, however, that the nature of the proposed model was sufficiently interesting to be worthy of inclusion in this review.

Fox developed a "step model" for the prediction of driver route choice in which

> "the driver looks at each variable in turn and eliminates from consideration the routes that are judged unsatisfactory, based on the measurement of the particular variable being considered. In the model, the driver looks at as many variables as are necessary to eliminate from consideration all but one route, the route that the model predicts that the driver will take."
> (Fox, 1965, p.5)

It should be noted that the order in which the variables were considered (a point crucial to the success of the model) was defined, not by respondents' rankings of them, but by previous analyses designed to find out which single variables best predicted the observed route choices! Cognised travel time emerged as the best single variable (with 83.3 percent of the 72 predictions made being correct) but Fox found that using measured travel time as the first variable in the step model led to better overall predictions at the second and third steps.[1]

Although his study emphasised objective measurements rather than subjective images, Fox's formulation of the "step model" did identify a procedure followed in many real

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1. Fox used apparently arbitrary threshold values as a selection mechanism. If the difference between the values, for two routes, of a particular variable did not exceed the threshold value then no prediction was made. In the case of cognised travel time the threshold value was 4.1 minutes and predictions of route choice were made for only 72 of the 190 respondents examined.

world choices. Alternatives that cannot be separated on the most important criterion are evaluated again on the basis of further criteria in order of decreasing importance until one of the alternatives is seen to be clearly better than the others.[1] It would be desirable to build this kind of mechanism into any model designed to link cognition and behaviour. Model VI (Sequential Decision Making) in Chapter Six has been designed specifically to test this kind of procedure.

The work of Mackay et. al. (1975) focussed on the differences between cognitive distance and real distance and explored, in particular, the relative ability of these two measures to reproduce individual consumer behaviour. A multi-dimensional scaling algorithm was used to derive cognitive maps of shopping opportunities.[2] Measures of the cognitive distances to six supermarkets were obtained from the map prepared for each respondent and then correlated with the frequency of visiting each market. For 65 percent of the respondents cognitive distance generated higher correlations than actual physical distance.[3] The

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1. Slovic et. al. (1974) referred to this as a lexicographic decision rule. Flowerdew (1973) used a similar procedure but worked only with binary measures (presence/absence or satisfactory/unsatisfactory) of the criteria.
2. Mackay et. al. prepared a deck of cards with each card listing two locations drawn from among the six supermarkets and the respondent's residence. Thus the 21 cards in the deck included all possible pairs of the seven locations. Each respondent was asked to arrange the cards in rank order, according to how close he or she believed the pair of locations on the card to be. This ranking provided the input to the multi-dimensional scaling algorithm that generated a subjective map of the seven locations for each respondent.
3. Cadwallader (1975) also showed that cognitive distance was a better predictor of consumer behaviour than real distance.

interpretation of this result is limited, however, by the assumption that consumer spatial behaviour was related solely to the cognitive distances separating the consumer's residence and each of the various shopping opportunities. Recognition of this limitation serves to emphasise the point that cognitions of spatial alternatives have many facets. It would be unrealistic to restrict the image measurements used in a cognition-behaviour model to a single criterion.

R. Hudson (1972) used personal construct theory and the repertory grid to measure the multivariate images that respondents held of foodstuffs shops in Bristol (and also the image held of a "preferred" shop). It was hypothesised that:

> "there will be some relationship between the location of shops in a person's cognitive space, relative to the "preferred" shop, and the relative frequency with which shops are patronized."
> (R. Hudson, 1972, p.7)

A multi-dimensional distance measure was used to calculate, over the set of personal constructs (or attributes) employed by each respondent, the subjective difference between the "preferred" shop and each stimulus shop and so to infer the "expected" probability of visiting any particular shop. The model was evaluated by correlating, for each individual, these "expected" probabilities with the actual probabilities of choice that had been obtained from shopping diaries kept by the respondents. Correlation coefficients calculated for 26 respondents ranged from 0.952 to -.957 with a mean of 0.173 and a median of 0.313. Hudson concluded that:

> "Despite all the short comings of the model, it does seem possible to meaningfully relate images to behaviour, albeit in this example in a particular, limited repetitive choice situation. This in itself would seem to constitute a step forward."
> (R. Hudson, 1972, p.14)

Furthermore, it is useful to note that the repertory grid methodology employed by Hudson minimised the need to impose the same artificial decision situation on all respondents by allowing each respondent to define an appropriate set of alternatives (shops) and also to identify the attributes most personally relevant to judgements of them.

Whereas Hudson worked with a measure of the cognised difference between ideal and actual alternatives, the two remaining studies used, as the selection mechanism, calculations of the total utility (attractiveness or subjective worth) associated with each alternative. In the first study (L. Hudson, 1972) images held of two competing shopping centres in Sydney were measured by having eight attributes rated on five-point scales that ranged from "not very good" to "very good". The eight ratings given to a particular centre were summed to define a measure of "aggregate shopping centre utility" for each respondent. Although detailed results are not clear from Hudson's text, it does appear that 40 percent of the persons who preferred one centre (Top Ryde) on the basis of total shopping centre utility actually patronised the other (West Ryde).[1] Additional information collected from respondents at the time of the survey indicated that many of these

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1. No information is given about the number of people who preferred West Ryde but patronised Top Ryde.

"unpredictable" cases cited reasons such as "closeness to the centre patronised", "the hill in the direction of Top Ryde" and "familiarity" for their choice of centre. Hudson concluded that this group of consumers were not behaving inconsistently if net utility (defined as total utility minus the costs associated with patronising a centre) rather than total utility, was used to identify expected behaviour. Equally, it could be argued that the utility measure employed was incomplete because it did not include some assessment of location convenience. Although the principal concern was to

> "...examine the returns aspect of shopping centre utility and not the cost element..."
> (L. Hudson, 1972, p.26)

it is difficult to see how a meaningful model of choice behaviour could be based solely on the cognised rewards of the alternatives without taking account of possible disadvantages or subjective costs that might also be present in the same alternatives.

A much more sophisticated treatment of consumer choice behaviour, at both theoretical and empirical levels, was presented by Hansen (1969, 1972). After a long discussion of relevant psychological processes Hansen identified crucial variables in the choice process and proposed an empirical model for the prediction of consumer choices. This model depended on four main components:

(a) attractiveness - the overall evaluation of a given alternative,

(b) salient values - the characteristics or "evaluative attributes" of the alternatives that are valued by the decision-maker and can, therefore, influence the decision process,

(c) value importance - the relative weight accorded to a given salient value by the decision-maker and

(d) perceived instrumentalities - the amounts of the various salient values contained within, or possessed by, a given alternative as perceived by the decision-maker.

In the experiments reported by Hansen measurements of value importance and perceived instrumentalities were obtained on 11 or 21 point scales anchored by appropriate polar adjectives or adjectival phrases. The attractiveness of each alternative was then calculated according to the formula (Hansen, 1972, p.210):

$$A_i = \sum_{j=1}^{m} V_j \cdot I_{ji}$$

where A_i = the attractiveness of alternative i

V_j = the value importance of the jth evaluative attribute

I_{ji} = the perceived instrumentality of alternative i with regard to the jth evaluative attribute

m = the number of evaluative attributes.

For each respondent the alternative with the highest attractiveness value was compared with the alternative actually chosen in a simulated decision situation. Generally high success rates were achieved.[1] It must be remembered,

1. Success rates reported for the various choice prediction experiments were (Hansen, 1972, pp.250 and 287):

Experiment	Correct Predictions (percent)
Hairdryer I	91.2
Hairdryer II	76.3
Restaurant	71.1
Travel Choice	77.6
Menu (9 alternatives)	63.3
Car	78.4

however, that in all but one experiment only two alternatives were considered. Furthermore the decision situations were carefully constructed and respondents were supplied with detailed information about the alternatives. Both of these points would tend to improve the success rate: the first by reducing the number of possible incorrect predictions and the second by removing much of the inherent variability in individual (unassisted) cognitions of the alternatives. Nevertheless, Hansen did make use of the important idea that the various attributes considered in a decision could make different contributions to that decision. He also emphasised the role of multi-attribute images and devised a simple procedure to calculate the total "attractiveness" of each alternative.

Although it is unlikely that the five studies reviewed here cover all individual level cognition-behaviour models relevant to spatial behaviour that have ever appeared in the literature it is apparent that geographers have made very few steps in that direction.[1] The studies described above are not entirely without blemishes.[2] They do, however, provide most encouraging evidence that cognition-behaviour models are feasible and also capable of achieving close fits

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1. Hansen, after an extensive survey of the literature, could list only five studies in the fields of psychology and marketing that had conducted experiments with similar types of models. (1972, p.211)
2. Neither Hansen (1969, 1972) nor L. Hudson (1972) gave any consideration to the validity of summing their "image" ratings to generate total utility or attractiveness scores. In using the calculated cognitive difference between each shop and a "preferred" shop to predict them probability of visiting that shop, R. Hudson (1972) had the problem of ensuring that the "preferred" shop was a realistic, rather than an Utopian, ideal.

between predicted and observed behaviour. More important for our present purposes is that they serve to highlight various elements that might be included in such a model: (a) the alternatives recognised by each actor, (b) the attributes considered relevant to the evaluation of those alternatives, (c) the use of those attributes as the basis for measuring the image held of each alternative, (d) a selection mechanism to combine multi-variate image measures into a single estimate of total subjective worth and hence define the "best" alternative and (e) a procedure for comparing behaviour predicted by the model with the behaviour actually observed. Table 1.2 summarises the occurrence of these elements in the five models considered. Clearly, the various models differ in the elements that they incorporated. R. Hudson (1972), for example, was the only study that allowed each respondent to define both the alternatives considered and the relevant attributes for themselves. The other studies imposed common sets of these elements on all respondents.

The main objective of the present research is to develop an integrated model linking measured cognitions with observed behaviour. Studies reviewed above highlighted several aspects of human decision-making that would need to be incorporated in the conceptual formulation of such a model. Furthermore, the review introduced various methodologies that have been used to provide operational definitions for cognition-behaviour models and revealed some of the problems associated with those methodologies. Chapter Two describes the conceptual model developed for

TABLE 1.2 <u>Elements of Individual Level Cognition - Behaviour Models</u>

	Fox (1965)	Mackay et. al. (1975)	R. Hudson (1972)	L. Hudson (1972)	Hansen (1969,1972)
(a) alternatives - number modelled	2-4	6	3-12	2	2[a]
- individually defined			X		
(b) attributes - multi-attribute images	X		X	X	X
- benefits and costs in images	X		X		X
- personal definition of relevant attributes			X		
- individual rating of attribute importance					X
(c) image measurements - direct estimates	X				
- rank ordering		X			
- rating scales			X	X	X
(d) selection mechanism - sequential	X				
- multi-dimensional distance		X	X		
- utility calculation				X	X
(e) comparison of prediction and behaviour					
- percent correct	X			X	X
- correlations		X	X		

a. In the case of menu choice 9 alternatives were considered.

the present study and goes on to discuss in detail the procedures adopted to make that model operational so that it could be tested in the context of mode-choice decisions for inter-city travel in Malaya. Attention turns now to the second of the objectives established for this study: the question of inter-personal similarities in decision processes.

1.2.3 Variables Affecting Cognitions and Behaviour

In their explicit focus on the links between cognition and behaviour, the models described above have tended to be static, simplistic and mechanistic, ignoring a variety of other variables that have been shown to affect cognition and behaviour through, or independent of, the actual decision process. Some of these variables are now reviewed briefly under the headings: (a) motivation, (b) information, (c) decision mechanics and (d) opportunity.

(a) motivation: Motivation is a crucial aspect of purposive behaviour: without motivation there is no goal to direct the behaviour. Much attention has been devoted to the concept of "stress" as a possible way of isolating and investigating various factors that contribute to motivation (Wolpert, 1966; Golant, 1971; Clark and Cadwallader, 1973; Clark, 1975). Tully (1968), however, pointed out that behaviour is much more than just an act stimulated by motivation: the actor has to be able to define the motivating situation in such a way that a solution is possible.

(b) information: Before an actor can make a decision about a situation (or indeed be motivated by it) he must have some minimal level of knowledge, cognition or information about that situation. It is widely accepted that the decision-maker need not have accurate knowledge of his situation (Webber et. al., 1975). More important, however, is the fact that information possessed by any one decision-maker varies in both quantity and accuracy over time. Some workers have explored the usefulness of psychological learning theories for research in geography (Golledge, 1967, 1969, 1970; Burnett, 1973). Others have translated the notion of learning into the search behaviour undertaken to acquire additional information (Brown and Holmes, 1971; Dicken, 1971).

(c) decision mechanics: Strength of motivation affects the amount of time spent on the search for new information and also the effort allocated to evaluating that information before actually reaching a final decision. Pred (1967) suggested that the ability to use information varied among decision-makers and Dicken (1971) wrote of the importance of "aspiration levels". It could well be that these variables have implications for the nature of the mental process employed in making a decision: that is, whether it becomes a "maximizing" or a "satisficing" one (Hansen, 1969, 1972). A variety of other variables has also been proposed as having effects on the operation of decision processes. Work done by Sonnenfeld (1969, 1971) highlighted the role of differing types of "environmental personality". Adams (1973) explored the effect of behavioural commitment and new, contradictory information in producing "cognitive dissonance" within the decision to visit a beach. The "demonstration effect" of proximity to existing adopters was suggested by Whitehand and Pratt (1975) as an alternative to existing assumptions about the role of distance decay in information flow and the production of neighbourhood effects in innovation diffusion studies.

(d) opportunity: Both Koopmans (1964) and Eyles (1971) have emphasised the distinction between the expression of a decision or preference to behave in a particular manner and the opportunity or capability to do so.

The important theme underlying the discussion of these variables is not so much that they (and many others?) always affect cognitions and behaviour but that they are revealed by individual differences among the actors involved in any given situation. Once the researcher has admitted the existence of individual differences (and the admission is virtually required by the adoption of a cognitive approach to the study of behaviour) he is left in something of a dilemma. On the one hand recognition of individual differences could be taken to mean that every decision-maker is unique and that generalisations across decision-makers are impossible. On the other, it could be argued that manifestations of individual differences are merely random fluctuations around behaviour defined by certain basic and universal principles. Most studies in geography, however, take the middle ground in this issue and argue an ecological/ sociological approach. These studies assume that people in the same area or people with the same characteristics behave in essentially the same ways for essentially the same reasons. Uniqueness is defined, not at the level of the individual, but at the level of the ecological or sociological cluster of individuals. Individual differences are still present but are regarded as random fluctuations from the general principles which affect the cognitions and behaviour of individuals within each cluster. Thus a belief in the inherent individuality of the human actor is preserved but, by clustering individuals into homogeneous groups, the basic principles underlying that individuality can at least be made knowable and subject to interpretation. From this viewpoint, behavioural research often becomes a search for those variables (and the crucial divisions or categories within them) that match major differences in cognitions and behaviour and so define the "natural" groupings of individuals vital to any understanding of behaviour. The search has been a long one and very consuming of research effort. Huff (1960), in particular, stands out for his discussion of a conceptual model that identified possible links (but not the "strength" of link) between the personal characteristics of decision-makers and various aspects of the decision process. Although some studies have drawn attention to situational variables indexing specific elements of the decision context, most attention has been directed at demographic and socio-economic aspects of the decision-makers.[1] Invariably, however, the implicit assumption is that these variables,

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1. White (1966), Baker and Patton (1974) and Slovic et. al. (1974) have discussed the use of situational variables. Many studies have assumed that socio-economic variables generate different cognitions and decision processes. See, for example, Peterson and Neumann (1969), Knight and Rickard (1971), Moyer (1972), Hartgen (1972), Rowley and Wilson (1975), Mackay et. al. (1975).

once relationships with cognition or behaviour have been revealed, are prescriptive of "natural" groupings of actors and hence define common patterns of future behaviour.[1]

The second main objective of the present study focusses on this theme but from a slightly different approach. Instead of assuming that "natural" groupings exist the statement is taken as an hypothesis. It is the testing of this hypothesis that forms the second aim of this thesis. Selected demographic, socio-economic and situational variables, most of which have been widely used in behavioural research, are examined to see if they do tap marked differences in cognitions and behaviour and might, therefore, index basic explanations of behaviour. It is believed that the location of the study in Malaya provides an excellent social laboratory for this purpose. As a developing country with a variety of ethnic groups from different cultural traditions and a wide range of economic status levels it provides a marked contrast with the relatively homogeneous white, middle class and American samples that feature in so many studies. If cognitions and decision processes are significantly related to the actor's personal characteristics then the relationships should be clearly revealed by a heterogeneous Malayan sample.

1.3 The Arrangement of this Thesis

The above discussion has already introduced two of the three main objectives of this study. Most attention will be given to the first, the attempt to develop a conceptual

1. R.J. Johnston (1971b) made an explicit test of ecological clustering in place cognition.

and empirical model for the prediction of individual choice behaviour. Data on the choice of mode for long distance passenger travel in Malaya are used for an empirical test of this model.

In the second place, an examination is made of the hypothesis that similar people have similar ideas about particular modes of transport. Tests are made of variables that index the personal characteristics of the individuals studied, their previous experience of various modes of transport and the particular decision situation that they were in.

The third objective of this study lies in the collection of basic data about the mode-choice decision for long distance travel in Malaya and the assessment of the relevance of that data for an understanding of the pattern of mode use. Information will be presented on (1) the awareness that travellers have of alternative modes for inter-city journeys, (2) the advantages and disadvantages that travellers reported from their experience of particular modes, and (3) the images that respondents held of the main methods of transport used for long distance travel.

All three objectives are carried forward throughout the thesis though certain sections emphasise themes relevant to one objective rather than the others. An introduction to the behavioural approach and a discussion of various existing models linking cognition to behaviour has been given in this introductory chapter. Chapter Two draws together the themes that emerged from the discussion of existing models into a conceptual framework for the study of geographic behaviour. The methods adopted to give this framework an operational definition for a study of mode-choice decisions affecting long distance passenger transport in Malaya are discussed at some length. A brief summary is also given of the field procedures used to gather data on mode-choice decisions needed to test the framework. Chapters Three to Six analyse that information in terms of the perceived context of the mode choice decision, the main criteria used to evaluate alternative modes, the images held of those modes and the link between mode images and mode choices. The thesis ends with a critical review of the conceptual model, the methodological framework and the empirical performance of the model.

CHAPTER TWO: CONCEPTUAL AND METHODOLOGICAL FRAMEWORKS

The prime objective of this study is to design and test a fully operational model for predicting mode-choice decisions. It is therefore necessary, instead of trying to reproduce precisely the complex psychological processes involved in the act of making a decision, to base the empirical model on a relatively simple conceptual framework. To make an operational model feasible and to ensure that data collection did not become unmanageable (for both researcher and respondent) some of the more sophisticated features of recent models of cognitive behaviour have not been included in the framework used here.[1] Furthermore, it has been necessary to assume that the behaviour under consideration is the product of a conscious decision making process. Many instances of geographic behaviour might have originated with conscious decisions at some particular point in time but with repetition they have become habitual and represent automatic responses to a given set of circumstances. Journeys to work and to shop can often be put into this category and attempts to explain such patterns present peculiar research problems of their own. Here attention is directed to those situations where the individual actor has to examine the various courses of action available, weigh up the consequences of each and to select one to be put into operation. It is argued that restricting the scope of this study to inter-city journeys

1. See, for example, Downs (1970b) and Pocock (1974).

does help minimise the possibility of involvement with habit behaviour. For most people a journey from one city to another is a relatively infrequent event and so the decisions involved are probably considered anew on each occasion.[1]

Despite these simplifications and assumptions it is argued that the conceptual framework presented here does not grossly misrepresent the decision processes that generate many human geographic patterns. After a description of the framework, later sections discuss the methods used to make it operational for a study of mode-choice for inter-city passenger travel in Malaya.

2.1 A Conceptual Framework for the Study of Geographic Behaviour

The present study focusses strongly on the behavioural or process, rather than the structural, approach to the explanation of geographic patterns. It is useful to emphasise this distinction by expressing the framework, at its broadest level, in terms more usually associated with physical geography (Figure 2.1). A closer look, however, shows that the terms "initial controls", "energy", "process" and "response" are not at all inappropriate for this kind of

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1. If transport facilities are taken as given then the mode-choice decision is only one of five decisions involved in generating transport patterns. The others are (a) the initial decision to travel, (b) destination choice, (c) selection of a route and (d) the choice of timing of the journey. Once a person has decided to travel, destination choice is normally the first of the remainder to be settled but there is no evidence on the order in which the others are decided. In practice a decision on one aspect could determine or severely constrain the decision on another. Taking mode-choice out of this context could, therefore, be unrealistic.

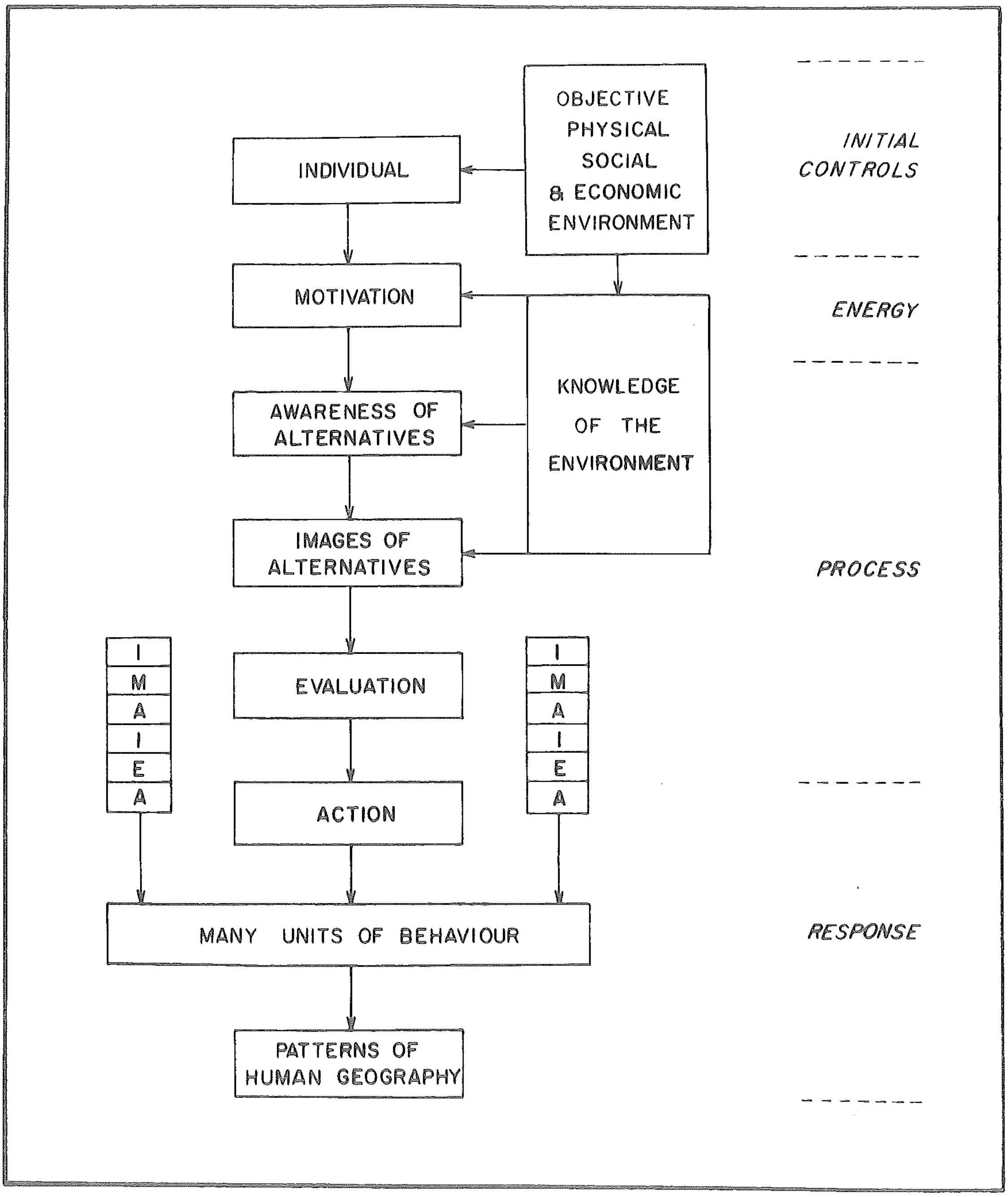

Figure 2.1 Conceptual Framework

problem in human geography.

The initial controls are provided by the objective facts of the physical, social and economic environment and by the location of the individual actor within that context. It must not be imagined that the actor is aware of all or any of these facts; indeed it is argued here that most actors hold only a limited and often inaccurate knowledge of their surroundings. In this study the objective facts of the environment are important only in so far as they determine whether or not a particular course of action selected by the decision-maker can be implemented. It is the subjective facts, the world as the actor believes it to be, that influence the choice of action.

Energy is introduced into the system by human psychology generating, within the individual, motivation for a specific act of geographic behaviour, whether it be a desire to travel from one city to another, a need to make a living from a given area of farmland or the hope that a new manufacturing plant will become a profitable economic enterprise. This driving force acting upon and within the individual might be strong and insistent or weak and easily suppressed; it could be a simple basic need or perhaps a complex combination of multiple objectives. Regardless of their nature or psychological origin, such motivations are the prime source of energy for the establishment, maintenance and alteration of human geographic patterns.[1]

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1. In many cases, particularly in environmental hazard situations, the motivation to behave is itself a function of the actor's knowledge and interpretation of his environment. See, for example, Saarinen (1966).

Motivations are transformed into specific actions by the mental processes of the individual which enable him to (1) be aware of certain alternative courses of action open to him, (2) develop a more or less coherent image of each alternative and (3) evaluate those images and select the "best" alternative for implementation.

First, he is aware (or, from information collected because of the motivation, becomes aware) of various courses of action by which he might satisfy the energising motivation. These known alternatives are important because they form the context of the individual's decision. If an (physically available) alternative is not recognised then it cannot enter the decision process and it cannot be selected for implementation. There is, therefore, considerable interest in identifying the particular alternatives apparent to any decision maker as this initial cognition could severely restrict the behaviour finally adopted. It is also likely that an actor's explanation of his decision would be greatly influenced by the particular alternatives considered. Thus, a person who chose to travel by car rather than train might justify his choice in terms of the superior speed of his car. However, had he been aware of only car and aeroplane as alternatives then he would probably refer to the lower costs of using his own car. If the reasons given to explain specific acts of behaviour are likely to vary in this manner then it is obviously important to try to define the choice context <u>as it appeared to the decision-maker</u>.

Second, if the individual is aware of more than one such alternative, he presumably has some sort of mental "image" of each one. Although these mental images originate in the objective facts of the environment, the image held by an individual of a particular set of facts is often distorted (to a greater or lesser extent) by (i) the information available to that individual and (ii) his ability to process, retain and recall that information (Pred, 1967). As the individual is continually being presented with information about transport from advertisements, news media reports (especially of accidents) and his own travel experiences as well as those of friends it is likely that mode images and the individual's cognition of a particular choice context are subject to marked changes over time.

Thirdly, the decision maker uses these personal images, as they existed at the time the decision was made, to compare and evaluate the alternatives believed to be available. He would select that course of action which best suited his own personal needs, situation and aspirations.

The response that follows these mental processes is the implementation of the selected act of geographic behaviour. It may be, of course, that none of the cognised alternatives are seen as suitable and so the "best" alternative is one of no action. Many acts of behaviour generated by procedures similar to those described in this framework combine to build up the patterns of human geography.

It is believed that this framework is sufficiently general to be applied to research problems in any area of human geography. The present study, however, is specifically concerned with choice of mode for inter-city passenger travel in Malaya and so Section 2.2 outlines the research methodology developed to provide an operational definition of the conceptual framework for this purpose.

2.2 An Operational Definition of the Conceptual Framework

The methods adopted to make the framework operational depended, in part, on resources available for the collection of data in the field. Ideally, a random sample of travellers would have been selected and each respondent interviewed in some depth to reveal (a) the motivation(s) behind the journey, (b) his personal definition of the choice context, (c) the mental images held of each alternative, (d) the bases of the evaluation procedure that defined the "best" mode and (e) the behaviour that actually took place. A combination of factors made this ideal procedure for data collection impracticable. Firstly, finance sufficient to support the multi-lingual team so essential for research based on interviews in Malaya was not available to this study. Even if it had been the major problem of sample selection remained. One approach might have involved sampling households and interviewing the "travellers" present. However, given the importance that has been placed upon the traveller's awareness of alternative modes and on the knowledge that he had of them at the time the mode-choice decision was made, this procedure would clearly encounter great problems because of the interval between the time the journey was made and the time of data collection. The problems of recalling the circumstances of a past decision would be complicated by the possibility that the respondent's cognitions of the transport situation had changed since (and even as a result of) his most recent journey. Any attempt to minimise these problems by selecting only those travellers whose last inter-city journey had been within a specified number of days or weeks would have greatly increased the finance required to obtain a useful sample size. A second approach would have removed the problems of recall and knowledge change by interviewing travellers at transport terminals immediately before departure on, or arrival from, an inter-city journey. Observation of Malayan transport terminals soon showed that they were hardly suitable places for in-depth interviews and that few travellers would be prepared to submit to such an interview immediately before or after a journey.

For these various reasons the ideal data collection procedure had to be replaced by two separate but complementary surveys. The first survey was designed to gain information on cognised choice context and on the particular mode attributes seen as important in mode-choice decisions, within the shortest possible time after the decision was actually made. It was carried out by having self-administered questionnaires distributed to persons about to begin, or in the course of, an inter-city journey and so this survey was labelled the In-transit Survey.[1] As the In-transit Survey questionnaire needed to be kept short to encourage travellers to respond to it, detailed investigation of mode images was impossible. Furthermore, the

1. Administrative details of the data collection surveys are discussed in Section 2.3 and in Appendices 2 and 3.

technique used to measure mode images (the semantic differential) required some prior definition of the most important criteria used by Malayan travellers to evaluate modes of transport. Accordingly, the In-transit Survey was designed to obtain such information and so provide a base for a separate survey to gather data on the mental images held of the main modes of passenger transport. The resulting Mode Image questionnaire was distributed among selected groups of school pupils, university students, government employees and workers in private business. Those respondents to the In-transit Survey who had supplied their name and address were also invited to take part in the Mode Image Survey.[1]

It is within this context of two separate surveys that the conceptual schema had to be implemented. The operational definitions actually adopted for each stage of the model are now described.

2.2.1 Initial Controls

Data collection was carried out in Peninsular Malaysia and the Republic of Singapore during 1970. The objective facts of the environment that impinge upon this study are therefore found primarily in the structure of the urban system and the passenger transport network that existed in Malaya at that time. The operational definitions adopted here have had the effect of restricting this study to a range of inter-city travel behaviour somewhat smaller than

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1. Administrative details of the data collection surveys are given in Section 2.3 and in Appendices 2 and 3.

that theoretically possible within the objective facts of the environment.

Many different modes of transport (from walking and hitch-hiking to bicycle and ox-cart) could be regarded as potential methods of travelling from one city to another.[1] For various practical reasons the number of modes that could be handled during data collection and data processing was limited and so six "inter-city transport modes" were defined for the purposes of this study. These were: (i) scheduled air services (hereafter aeroplane or air), (ii) scheduled long distance omnibus services (bus), (iii) scheduled trains excluding railcar services (train), (iv) "long distance" taxis (taxi), (v) private car (car) and (vi) private motorcycle (motorcycle).

In 1970 there were sixteen urban areas in Malaya that had populations of over 50,000 and could therefore be termed cities.[2] Several of these, however, were not linked by scheduled air or rail services and so they did not support the full range of travel facilities defined above. As the analysis and interpretation of choice context data required a common base, the "cities" that did not support all six

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1. All the modes listed (and several others) appeared in "possible mode" sets reported by respondents to the In-transit Survey. The number of possibilities increases even further if multi-mode journeys are counted.
2. In fact only two, Singapore and Georgetown, were officially designated as "cities". Kuala Lumpur, Ipoh, Johor Baharu, Kelang, Petaling Jaya, Melaka (Malacca), Seremban, Alor Setar, Butterworth, Muar, Kota Baharu, Taiping, Kuala Terengganu and Batu Pahat also had populations of over 50,000 in 1970 (Chander, 1971). Note, however, that for the purposes of this study Georgetown and Butterworth have been taken as a single urban area and, similarly, Kuala Lumpur and Petaling Jaya.

"inter-city" modes were excluded from consideration. This decision determined which of the responses to the In-transit Survey were retained for analysis. Table 2.1 sets out the "inter-city" journeys that remained valid under these definitions.[1]

2.2.2 Energy

The energy component of this model is established by the motivation to travel between one city and another. In practice this motivation was defined in two separate ways. Questionnaires returned from the In-transit Survey revealed the travel motivation automatically but only those that dealt with valid "inter-city" journeys (as defined above) were selected for further analysis. The Mode Image Survey, however, was not tied to a specific act of travel behaviour. It was therefore necessary to impose the "inter-city travel" motivation on this survey by asking respondents to complete their questionnaire in relation to a specified inter-city journey. Although this procedure is not realistic in the same way that the In-transit Survey gathered information on an actual journey, it does help generate a meaningful simulation of the mode-choice decision.

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1. The actual amount of passenger traffic along these routes in 1970 and the way that traffic was shared among the six "inter-city" modes is not known. While gross figures for certain modes (over all routes and services) can be readily obtained there is very little detailed information available on the modal split of passenger traffic in Malaya. An attempt to fill this gap was made in the course of the present study and estimates of the modal split on selected routes for 1970 are presented in Appendix 1.

TABLE 2.1 Valid "Inter-city" Journeys[a]

1. Kuala Lumpur[b] to Ipoh (or vice versa)
2. Kuala Lumpur[b] to Georgetown/Butterworth[b] (or vice versa)
3. Kuala Lumpur[b] to Singapore (or vice versa)
4. Kuala Lumpur[b] to Alor Setar (or vice versa)
5. Kuala Lumpur[b] to Kota Baharu (or vice versa)
6. Georgetown/Butterworth[c] to Ipoh (or vice versa)
7. Georgetown/Butterworth[c] to Singapore (or vice versa)
8. Georgetown/Butterworth[c] to Alor Setar (or vice versa)
9. Ipoh to Singapore (or vice versa)
10. Ipoh to Kota Baharu (or vice versa)
11. Kota Baharu to Singapore (or vice versa)

a. These journeys have been defined as "inter-city" journeys for the purposes of this study because, in each case, the six modes (aeroplane, bus, car, motorcycle, taxi and train) are viable modes of transport. A number of questionnaires were completed for Kuala Lumpur to Melaka journeys but these were excluded from the analysis because Melaka has no rail link. Figure 2.2 locates each of these "cities" and also other places mentioned in the text.

b. Kuala Lumpur and Petaling Jaya are administratively distinct but in almost every other sense they can be regarded as a single urban area. Petaling Jaya is located between Kuala Lumpur and its airport. Petaling Jaya residents wishing to travel north or south by rail have to use the railway station in central Kuala Lumpur.

c. Although physically separated by Penang harbour Georgetown and Butterworth have been considered together because
   (a) They are linked by an efficient passenger and vehicular "mass transit" ferry service
   (b) Butterworth acts as the rail and bus terminus for Georgetown
   (c) Bayan Lepas (on Penang Island) provides air both Georgetown and Butterworth.

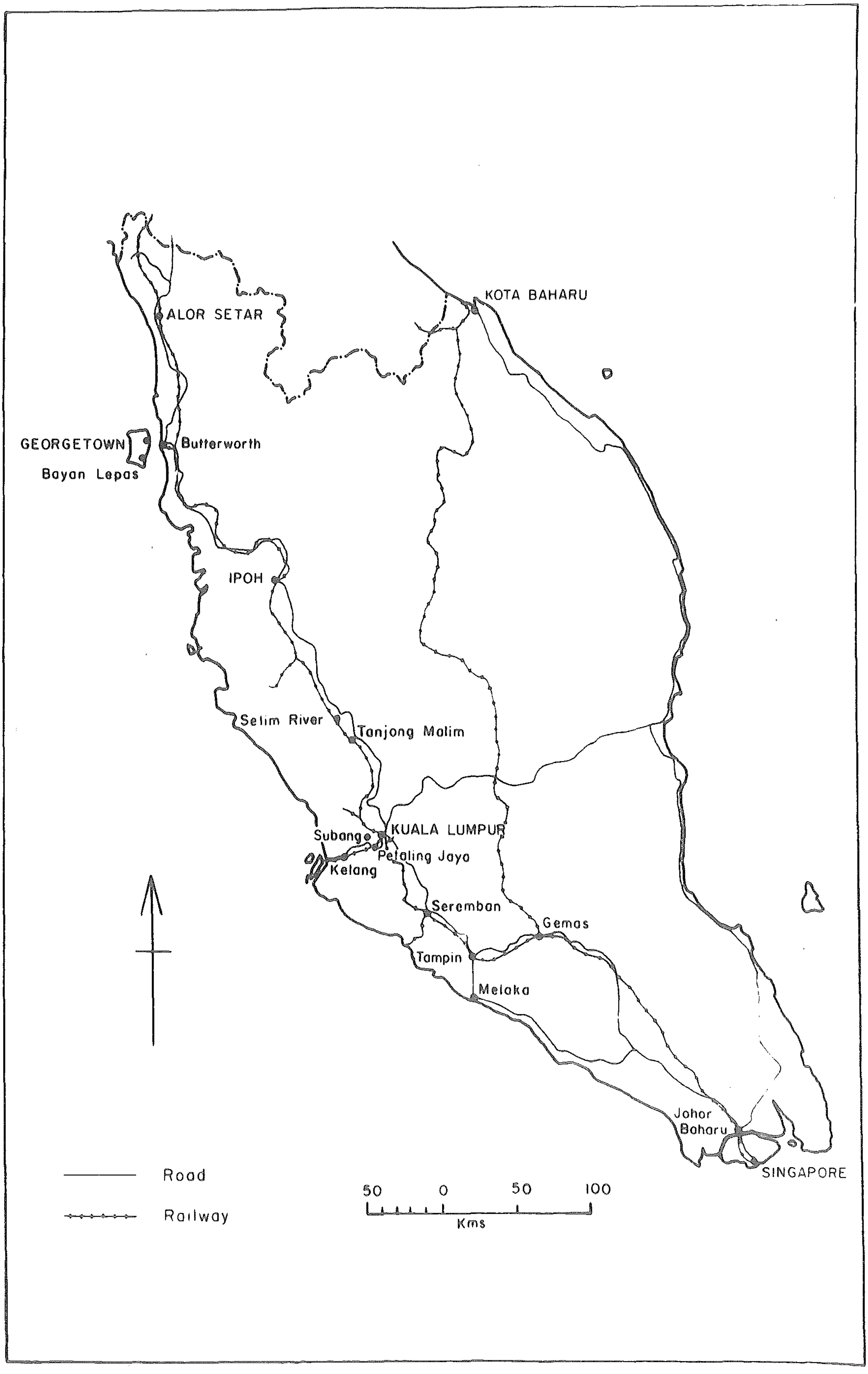

Figure 2.2 <u>Study Area</u>

2.2.3 Process

Three distinct elements of the decision making process were identified during the discussion of the conceptual framework. They were (a) the awareness of alternative courses of action (choice context); (b) the mental image held of each alternative (mode image) and (c) the selection of the "best" alternative (evaluation). The methods adopted to operationally define each of these three elements of the decision process form the core of this study and are now discussed in some detail.

2.2.3.1 Choice Context

One of the main weaknesses of the various cognition-behaviour models reported in Chapter One was a failure to describe the choice context as it appeared to the decision maker.[1] If the researcher was unaware of certain alternatives or inferred the existence of some that were not, in fact, recognised by travellers, his interpretation of reasons given to explain the choice of a particular alternative could well be in error. It is argued here that knowledge of the cognised choice context is vital for explanation and interpretation of human geographic patterns.

Any person contemplating a journey between two cities is normally faced with a number of different modes of transport that he might use for that journey. Following the lead of W. Firey, venn diagrams borrowed from mathematical set theory, are used to conceptualise a traveller's cognition of

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1. Of all the models discussed, only R. Hudson (1972) allowed respondents to define the choice context as they saw it themselves.

the context of his mode choice decision (Firey, 1960).

Ultimately the decision concerns modes that are part of the universal set, U, of all modes of transport that have ever existed or will ever come into existence (Figure 2.3). For a given journey between city A and city B on a certain date the choice context narrows to the set, S, of all modes which are available for transporting passengers between A and B on that date. The intending traveller is probably aware of only some of the modes within S and so P defines the set of possible alternatives that actually enter the first stage of his decision process. It is also possible that the decision maker may recognise as a viable alternative some mode (or modes) not actually available for the journey in question (Actor 2 in Figure 2.3). In some situations, modes viewed as possible alternatives might be immediately discarded as impracticable for the individual, thus reducing the choice context to the set, R, of modes considered practicable alternatives for this journey.[1] It is these modes that are evaluated according to the traveller's knowledge of them and in terms of the circumstances of the desired journey, to reach a decision on the particular mode, M, to be used.[2]

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1. A sixth set, of impracticable modes (defined as those members of the possible modes set that did not appear in the practicable set), was also used in analysis.
2. It should be made clear that sets can coincide (as with S and P for Actor 1) or that sets P and R might extend beyond S (Actor 2). The traveller, through inaccurate knowledge of his environment might select a mode that was not available; a situation that could easily happen if a particular service was suspended. In this situation any attempt to implement the decision could obviously fail, the intending traveller would update his information about the choice context and, unless the motivation to travel had been quashed, commence a new evaluation process.

   The set M would normally contain just one mode. If, however, the mode-choice decision resulted in "no action" then M would be the null or empty set.

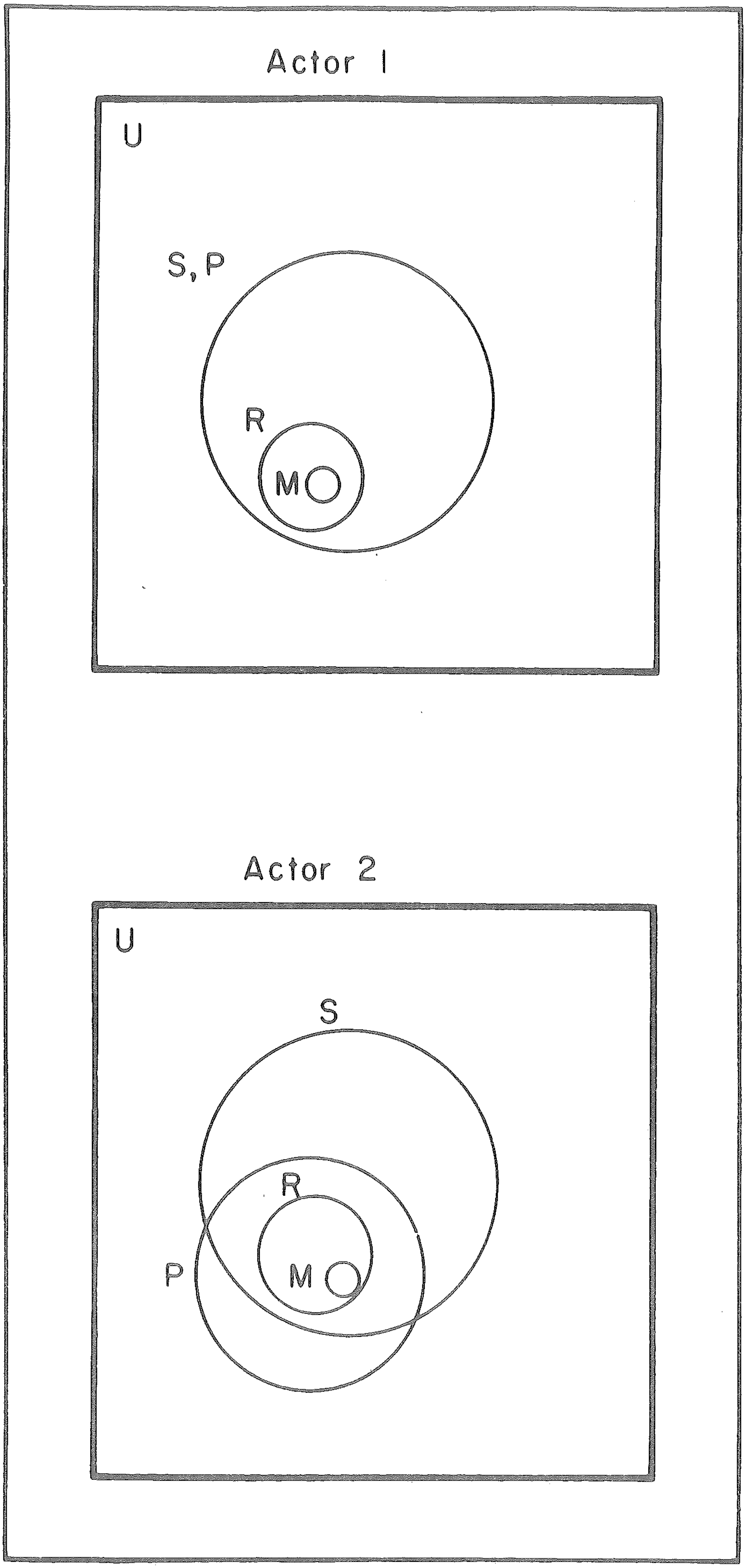

Figure 2.3 Conceptualising the Choice Context

For this study the sets P and R were defined by questions in the In-transit Survey which followed immediately after the respondent had specified the origin and destination of his journey. First, the set of possible modes was defined by the query "Do you know of any other ways of travelling between those two places?" Second, the set of practicable modes was derived from "What other methods of transport could YOU have used for this trip?" Although these questions referred explicitly to "other methods of transport" and excluded the current travel mode from the response alternatives provided, all the analyses of the choice context responses presented in Chapter Three include the travel mode as both a possible and a practicable alternative.[1]

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1. The "travel mode" was the mode being used by the respondent when he received the In-transit Survey questionnaire. (See Appendix 2a for a copy of the questionnaire.) The problem of supplying response alternatives for these questions was considered at some length as the mere presence of a list of modes could stimulate a response that might otherwise not have been given. One of the disadvantages with self administered questionnaires is that respondents can (and do) read through the questions before actually starting to make their responses. In this case, even if the choice context questions had been left completely open, particular responses could have been stimulated by the list of modes attached to a later question about travel experience. Motivation to respond to a self administered questionnaire is affected by the apparent simplicity or complexity of the task and so it is usual to supply response alternatives for as many questions as possible. This procedure was therefore adopted for the choice context questions but the alternatives given included COASTAL SHIP (not a usual method of passenger travel in Malaya during 1970) to indicate that the modes listed were not all necessarily viable alternatives. Nevertheless the responses analysed cannot be regarded as a true measure of the cognised choice context. As it is still possible that awareness of a particular mode was stimulated by the response alternatives given on the questionnaire, then the "true" (unassisted) knowledge of the choice context is likely to be even more constrained than indicated by the data described in Chapter Three.

2.2.3.2 Mode Image

It is considered axiomatic that the intending traveller evaluates the modes perceived as practicable alternatives in terms of the knowledge that he has of them. He may, of course, seek and obtain extra information about those modes during the evaluation process but at the moment of decision the choice is based entirely on knowledge he possesses. That knowledge may or may not correspond to the facts of reality: nevertheless it is the sole basis on which the decision was made. At this stage in modelling the mode choice decision, then, the problem amounts to obtaining some measure of the knowledge the individual possessed of the various modes he considered. Solution of this problem depends on two main issues.

First: it must be recognised that it is a physical impossibility to administer a measuring instrument to the decision-maker at the instant of choice. There will necessarily be a time gap between the decision and the measurement of that individual's modal knowledge. Every second of delay adds to the probability of change in knowledge and increases the difficulty of trying to recall the actual state of knowledge at the moment of decision. Moreover, in a research situation, the magnitude of the gap (and the likely amount of change in knowledge) will vary considerably from one respondent to another. This study, in fact, sidestepped the issue and simulated a mode-choice decision by asking respondents to rank inter-city modes in order of preference immediately after they had completed a questionnaire that sought to measure knowledge held of these modes.

Second: the problem demands an operational definition of knowledge. Knowledge, along with a number of similar concepts like attitudes, beliefs and perceptions, is an aspect of the mind that cannot be subjected to direct observation. It can only be approached by monitoring behaviour external to the mind. Psychologists recognise at least five basic groupings of methods for gauging the internal workings of the mind: physiological methods, learning methods, perceptual methods, association methods and scaling methods (Osgood, 1952). Two specific requirements of the present study clearly point toward the choice of a technique from among the scaling methods.

(a) It is obvious that any operational definition of knowledge for a mode-choice study needs to be multi-dimensional. Measurement of choice context is a simple one-dimensional procedure. The traveller is either aware of the existence of a particular mode or he is not. Mode images might, in some cases, be one-dimensional constructs but in general they would incorporate a number of different dimensions with cost, speed and comfort being the most obvious ones. Clearly, the operational definition employed should allow for this possibility.

(b) There should also be some way of obtaining measurements of the degree to which each mode possesses, or is associated with, each of these dimensions. Some modes will be associated with more speed, lower cost or greater comfort than others. The degree to which a given mode is believed to possess a particular quality is crucial in the mode-choice decision. Many of the factors that seem to influence mode-choice decisions cannot readily be measured on unambiguous physical scales as can cost or time. A viable operational definition of modal knowledge should therefore be able to handle dimensions such as comfort and safety as easily (and fairly) as it does the more readily quantifiable aspects like cost and time.

Given these requirements, two methodologies seemed appropriate for this study: (1) personal construct theory coupled with the repertory grid (Bannister and Mair, 1968) and (2) the semantic differential (Osgood, Suci and Tannenbaum, 1957). Repertory grid procedures have the advantage of allowing respondents to define for themselves the alternatives to be judged and the attributes on which those images were to be measured but they do require the presence of the researcher (or an assistant) throughout the data collection process. The intention of this study was to obtain a large sample covering as wide a cross-section of society as possible. Finance to pay research assistants was not available and so it was necessary to choose the semantic differential which is, basically, a self administered test.

Osgood, Suci and Tannenbaum designed the semantic differential to obtain quantitative measurements of the "meaning" that respondents associated with a given test stimulus or concept and this is, in essence, the same as the problem of measuring mode images. Instead of probing concepts like MOTHER, GOD, LOVE, CAPITAL PUNISHMENT or NEGRO a semantic differential is used here to investigate the meaning a respondent attached to AEROPLANE, BUS, CAR, MOTORCYCLE, TAXI and TRAIN.[1]

It is necessary to point out the assumption that the respondents reacted to the symbol "TRAIN" in the same way as if they had been confronted with the actual physical object. Fortunately the chances of a respondent reacting to a stimulus other than the one intended are minimal in this case. The words "aeroplane", "bus", "car", "motorcycle", "taxi" and "train" are part of everyday vocabulary. People might have different ideas about each of these modes but there can be little ambiguity about the physical object that each word refers to.

A semantic differential is based on a series of scales (descriptive ideas or attributes) that might be used to judge the concepts being studied, in this case, the modes of inter-city passenger transport. Each scale is defined by two polar adjectives to establish the idea or quality on which the given mode is to be rated. A respondent indicates his image of a mode on a certain scale by marking the appropriate section of the semantic differential format. Clearly, the particular set of scales used in a given instrument have a crucial effect on the utility of the data obtained.[2] The scales should cover all of the main attributes on which modes are judged; the omission of an

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1. Semantic differential studies have dealt with a wide variety of stimulus objects (concepts) including wheelchairs (Antler et. al, 1969); air-line meals and in-flight entertainment (Cotham et. al, 1969); shopping centres (Downs, 1970a); environmental hazards (Golant and Burton, 1970) and suburbs (R.J. Johnston, 1973).
2. Kasmar (1970) discussed this problem in the context of architectural images and conducted a study to define "a relevant, meaningful, and unambiguous lexicon of spatial descriptors" (1970, p.155).

important attribute could seriously handicap any attempt to model decisions. Conversely, if unimportant scales were included in the instrument data would be gathered for them but they could generate quite spurious results in a modelling exercise. In addition to this need for a careful identification of the scales used in a semantic differential it also seemed desirable to introduce some changes into the traditional semantic differential format. These two aspects of the operational definition of modal knowledge are discussed separately.

2.2.3.2.1 Semantic Differential Scales: Mode Descriptors

There is probably a very large number of different ways of evaluating modes of passenger transport for inter-city journeys and certainly many more than would be practicable for administration in a single questionnaire. If the measured mode images are to be meaningful inputs to a model of the mode-choice decision, the scales used should include as many as possible of those that are of major importance to inter-city travellers themselves. Two questions in the In-transit Survey were designed to obtain the information required to define a set of scales for the semantic differential.

(a) "We are interested in the reasons why you chose to travel by ....[1] rather than some other method of transport.

Please give the three main reasons why you chose ....[1] in order of importance: 1, 2, 3."

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1. In each case the name of the mode on which the In-transit questionnaire was distributed was inserted in the gaps.

(b) "We would like to know how satisfied you are with ....[1]

Please write down the three main disadvantages of travelling by ....[1] in order of importance: 1, 2, 3."

Responses to question (a) were labelled "mode-choice reasons" and those generated by question (b) were called "mode disadvantages". Two questions were used because it was felt that even though a mode was selected for a particular journey, the choice would have involved some "trade-off" among the desirable and the less desirable features of that mode. As the study aimed to develop a model of the mode-choice decision it was important to be able to gather information on both the attractive and unattractive aspects of mode images. Many respondents gave more than the requested three reasons and three disadvantages and so the first five of each for a given respondent were given three digit codes to facilitate further analysis. In the first instance this analysis consisted of combining the raw responses into a smaller number of more general categories so that both reasons and disadvantages could come together under common mode descriptor headings. The analysis of these reasons and disadvantages and the identification of the 21 most important mode descriptors for use as scales in the semantic differential are reported in Chapter Four.

2.2.3.2.2 Semantic Differential Format

Measurements obtained from a semantic differential

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1. In each case the name of the mode on which the In-transit questionnaire was distributed was inserted in the gaps.

consist of a series of numerical ratings which indicate the degree to which the respondent associated each scale (mode attribute) with a given concept (mode of transport). Seven checking spaces are usually provided.[1] A response in the central space (labelled 0 in Figure 2.4A) would indicate that the concept was believed to lie halfway between the two polar ideas that define the scale.[2] Response positions on either side of the central space accommodate reactions that are increasingly related to one or other of the polar ideas. The degree of relationship indexed by each of the three positions is usually defined by the adverb sequence: "slightly", "quite" and "very". By allocating the integer values 1 to 7 to the scale sections (in order from left to right) it is possible to obtain numerical measures of mode images. Thus a respondent that rated air as very fast (1 toward fast), car as slightly fast (3 toward fast) and bus as quite slow (2 toward slow) would be coded 1, 3 and 6 for the three modes (Figure 2.4A). There is evidence that the ratings obtained by a semantic differential are interval data and so they can be arithmetically manipulated to provide summary descriptive measures (means and standard deviations) or input to further analyses.[3]

For the present study two changes were made in the traditional semantic differential format (Figure 2.4A). The first alteration stemmed from the realisation that the usual format forced respondents to rate a concept on all the scales

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1. There may be more; Lilly (1965) used eleven.
2. Osgood et. al. (1957) also defined this response to mean that the scale had no meaning for the given concept (p.83).
3. Osgood et. al (1957) pp. 146-153. See also Heise (1969).

A.

AEROPLANE

FAST	3	2	1	0	1	2	3	SLOW
PLENTY OF SPACE	3	2	1	0	1	2	3	CRAMPED
NOISY	3	2	1	0	1	2	3	QUIET
RELAXING	3	2	1	0	1	2	3	TIRING
NEVER ON TIME	3	2	1	0	1	2	3	ALWAYS ON TIME
CROWDED	3	2	1	0	1	2	3	NOT CROWDED

B.

	FAST						SLOW	
AEROPLANE	3	2	1	0	1	2	3	4
BUS	3	2	1	0	1	2	3	4
TRAIN	3	2	1	0	1	2	3	4
TAXI	3	2	1	0	1	2	3	4
CAR	3	2	1	0	1	2	3	4
MOTORCYCLE	3	2	1	0	1	2	3	4

Figure 2.4 Semantic Differential Formats

Source: A - Osgood, Suci and Tannenbaum, 1957
B - present study

scales provided, regardless of how appropriate or meaningful a given scale appeared to be for that concept. Osgood, Suci and Tannenbaum recognised the problem and their formulation required that the centre checking space be used when a scale seemed to have no relevance for a particular concept (1957, p.83). This solution is consistent with their theoretical treatment of a multi-dimensional semantic space where the origin of the space (the centre point of each semantic dimension or scale) represented "no meaning". It does, however, confuse two responses which, at least intuitively, seem to be basically different. Both (a) "the scale has no meaning for this concept" and (b) "the concept lies half-way between the two polar ideas", would be measured by the centre check space.[1] For measurements of mode images this confusion seems to be particularly serious. A scale important for the evaluation of public transport modes might be irrelevant in the case of private transport.[2] There is also the problem of requiring a respondent to judge methods of transport on an attribute that he had never considered. The respondent might be able to complete the ratings on the "new" dimension but the measurements could hardly be valid for an analysis of that person's previous mode-choice decisions. These considerations led to the adoption of a separate check-space in the semantic differential format for use if "the idea might seem to have no

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1. Lundeen (1972) also recognised this difficulty.
2. The most obvious example concerns the quality of service provided by transport personnel (e.g. the helpfulness of air hostesses or booking clerks).

meaning for that particular method of transport".[1] This extra check-space is indicated by the numeral 4 in Figure 2.4B.

The second change came from initial experience with the traditional semantic differential format which suggested that, on some scales, the particular check position used by a respondent for a given concept, might have depended on the order in which the concepts were presented.[2] The present study focusses specifically on the evaluation of a given mode of transport in relation to the others considered in a decision process. In this context relative, rather than absolute, qualities of mode images are paramount and so the response format was changed to have all modes rated on one scale before moving to the next (Figure 2.4B). It was felt that this change would ensure maximum validity of data for comparing mode images (and hence for analyses of the decision process) without affecting the measurement properties of the instrument.[3]

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1. See the instructions supplied with the semantic differential questionnaire (Appendix 3a).
2. This conclusion was reached during an exploratory study that examined perceptions of settlements in Sabah. The judgements of settlement size lead to a suspicion that some respondents, once a very large or very small settlement had been rated, had in effect been forced to "shift" the"big-small" scale to accommodate an even more extreme size.
3. Osgood et. al. did suggest an alternative format "Form I", in which each "concept appears on the same line as the scale against which it is being judged, and the items are ordered in such a way that a maximum number of different concepts and scales occur between the repetitions of each concept and scale..." (1957, p.81). They seemed to prefer "Form II" (A in Figure 2.4) because it "is both easy to mimeograph...and easy to score... It also has the distinct advantages of greater constancy of meaning of the thing being judged and of being much more satisfying to the subjects of the experiment" (1957, pp.81-82). No evidence was presented to support the latter two claims. There is no reason to suspect that the format adopted here was any less "satisfying to the subjects" or encouraged any inconstancy "of meaning in the thing being judged". Furthermore, any possible tendency toward change occurring in the concept while the instrument was being completed would be minimised by the use of such concrete, everyday concepts as modes of transport.

For the Mode Image questionnaire in which the semantic differential was administered both the polarity of the scales (favourable to unfavourable) and the ordering of the modes under a particular scale were randomised.[1] This was done to prevent the formation of position preferences (within the seven checking spaces) and to minimise the possibility of a halo effect (the undiscriminating transfer of a favourable, or unfavourable, rating for a particular mode on a given scale to other scales as well). Instructions to respondents made it clear that modes were to be rated in terms of their suitability for long distance inter-city travel. Chapter Five presents the analyses of the mode images that were measured in this way. Additional material, obtained from the In-transit Survey, which allowed some explicit comparisons of perceived and actual mode characteristics for a limited range of attributes, is also presented in Chapter Five.

2.2.3.3 Evaluation

The intending traveller evaluates the modes he recognises as available to him, in terms of the knowledge that he has of them. Whichever mode best suits his purposes and the circumstances of the desired journey is then selected for use. Two simple numerical models have been devised in an attempt to reproduce the complex mental processes involved in a decision such as this. It is important to note that both models presume a rational decision-maker insofar as

1. Before analysis the mode image data were transformed so that the ratings for each scale ranged from 1 (very favourable) to 7 (very unfavourable): "irrelevant scale" responses were coded 8.

(1) they follow the usual rules and logic of arithmetic and (2) the "best" mode automatically becomes the predicted choice.

The first one, the Primary Model, sums the raw mode image values over all scales (or mode attributes) to obtain a total "score" for each mode (Table 2.2). This score can be regarded as a surrogate estimate of the total subjective utility (worth or attractiveness) that a given respondent associated with a particular mode. If the total "score" for each of the six inter-city modes is calculated for a particular respondent then the result of the mode-choice decision is defined by that mode with the best "score".[1]

A second model, the Basic Model, was devised to take into account a major weakness of the first. In summing the mode image values over all scales the Primary Model invoked the assumption that each scale was of equal importance to the decision maker. It is obvious from empirical work in choice behaviour from all fields (and not just mode-choice studies) that this assumption is unrealistic. Decision makers do give extra weight to certain attributes of the alternatives being considered while discounting others.[2] In this study

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1. As mode image ratings were coded from 1 (most favourable) to 7 (most unfavourable) the "best" mode was that one with the lowest mean score per valid scale. Mean scores, rather than gross totals, were used to allow for the "irrelevant scale" responses, which were given a value of 0 in the models. Numerical decision models, similar to the Primary Model, have been devised by Adams and Fagot (1959), Michaels (1966) and L. Hudson (1972).
2. See, for example, Shepard (1964), Wolpert (1965), Hoffman (1968) and Lundeen (1972). Behavioural studies in transport have often been concerned to estimate, for an aggregate population, the relative weights accorded to various attributes (Beckmann, 1969; Sommers, 1969, 1970, 1971; Golob, 1970).

TABLE 2.2 The Numerical Decision Models

Primary Model

$$M_i = \sum_{j=1}^{N} I_{ij}$$

Basic Model

$$M_i = \sum_{j=1}^{N} W_j I_{ij}$$

Where:

M_i	is	the total mode score for mode i
I_{ij}	is	the mode image rating for mode i on scale (mode attribute) j
N	is	the number of mode attributes for which image ratings were obtained
W_j	is	the numerical weight corresponding to the importance rating given to mode attribute j

In the summations "irrelevant scale" responses and missing data were counted as zero values. The actual selection of the "best" mode was therefore based on the mean mode score per valid scale (MM_i):

$$MM_i = \frac{M_i}{NN_i}$$

Where NN_i is the number of valid (non-zero) mode image values that contributed to M_i.

the unequal contribution of specific variables to the total score obtained for each mode was made operational by introducing a system of importance ratings.[1] Respondents to the Mode Image Survey were asked to indicate the importance they would attach to each mode attribute (or mode image scale) when choosing a mode of transport for a specified inter-city journey. These importance ratings were collected on a 5-point scale that ranged from "Very Important" through "Neither Important nor Unimportant" to "Very Unimportant".[2]

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1. Introduction of the notion that attributes are weighted in the decision process also leads to an alternative interpretation of mode images which highlights the distinction between "designative" and "appraisive" knowledge (Cox, 1972, p101). It is possible, if not probable, that the same individual (at essentially the same point in time) would make different mode-choice decisions depending on the specific context (route, purpose or urgency) of his proposed journey. This situation would require, according to the formulation of the Primary Model, that the individual held different sets of mode images for each route, purpose or level of urgency. In the case of the Basic Model, however, the same result could be achieved (with mode images remaining essentially constant for each individual) by assuming that attribute weights varied according to the specific context of the trip. Mode images would therefore be "appraisive knowledge" in the Primary Model and "designative knowledge" in the Basic Model. Designative images would not necessarily predispose the individual to a particular choice until the imposition of a decision context defined the relative weighting of the various attributes within the image. This second interpretation is the more attractive on intuitive grounds and also from the point of view of ongoing behavioural research. It seems logical that the particular context of a decision would affect the weights attached to mode attributes: the more urgent the trip the greater the emphasis that is put on "Speed" and "Travel Time". Varying the images rather than the weights would greatly complicate research into decision processes. Instead of monitoring change in a single set of measures it would be necessary to consider the possibility of change in several sets; one for each of the alternatives studied. Unfortunately the data available to this study are not suitable for a test of the distinction between "designative" and "appraisive" knowledge.
2. See Appendix 3a for the actual wording of this question.

By giving each response position on this scale an appropriate numerical value it is possible to weight the contribution of individual mode image ratings to the total mode score according to the relative importance attached to that mode attribute by the decision-maker. This was achieved simply by multiplying the mode image rating for a particular attribute by the numerical weight obtained from the corresponding importance rating.[1] The weighted values derived from this procedure were again summed over all scales to provide a "refined" total score for each mode.[2] As before the average mode score per valid scale was used to define the "best" mode.

Table 2.2 sets out the mathematical form of these two numerical models. Chapter Six presents the results obtained from running the Primary Model and the Basic Model. It also explores some implications of certain logical refinements to the Basic Model.

2.2.4 Response

In the normal behavioural sense the response component of the conceptual framework presented here would be represented by the actual implementation of the specific

1. Note, of course, that the numerical values associated with the importance ratings had to range from low (Very Important) to high (Very Unimportant) to mesh with the coding system adopted for the mode image ratings.
2. Numerical decision models (aggregate or individual) using weighted attribute measurements have been formulated by Hoffman (1960), Falk (1968), Beckmann and Wallace (1969), Hansen (1969, 1972), Sommers (1969, 1971), Sommers and Leimkuhler (1969), Demko and Briggs (1970), Golob (1970), Hartgen (1972), R. Hudson (1972), Moyer (1972), Burnett (1975) and Cadwallader (1975).

behaviour identified by the evaluation process detailed above. As the Mode Image Survey was not tied to a specific act of travel behaviour, however, it was necessary to simulate the mode-choice decision process and the resultant behaviour. Each respondent's knowledge of the six inter-city modes was measured by a semantic differential instrument and ratings were obtained of the importance that would be attached to specific mode attributes when choosing a mode for a given inter-city journey. The simulated decision was completed by asking each respondent to rank the six modes in the order that he or she would choose them for that same journey. For this study the behavioural response following the decision process is operationally defined by these preference rankings of the six modes. The success or failure of the numerical decision models is judged by comparing the preference rank order reported by each respondent against the rank order predicted by the model for that same respondent.

2.3 Data Collection Procedures

The data required for an empirical test of the operational framework outlined above was collected in two separate, but complementary, questionnaire surveys. Data on travellers' perceptions of the choice context and on the main attributes used to evaluate modes were collected by the In-transit Survey. Information on mode images, attribute importance and mode preference was obtained from the Mode Image Survey. Details of the design and administration of these two surveys are discussed separately.

2.3.1 In-transit Survey

One major objective of the first survey was to collect information on the mode-choice decision made by travellers as close as possible to the moment when that decision was reached, in an attempt to minimise the problems of recall, post hoc rationalisation and knowledge change. For reasons discussed in Section 2.2 a "hand out - post back" survey methodology was adopted. Distributing questionnaires to persons about to start a journey or while they were actually travelling ensured that responses were tied to a specific journey. There was no control, of course, over when the questionnaire was completed or, indeed, if it ever would be. Some made their responses while actually travelling; others waited until they had reached their destinations. Despite the low response rate that is normally expected from a self administered survey it was felt that this was the best way (short of conducting personal interviews within the travel vehicle) of obtaining reliable data on the decisions affecting actual travel behaviour.

Two major difficulties had to be faced in the construction of the In-transit questionnaire. As prospective respondents are easily deterred by the length and complexity of a questionnaire it was essential to keep this one as short and simple as possible. At the same time it was important to ensure as far as possible that any person who received a questionnaire could understand it and was, therefore, at least able to respond to it. In the Malayan situation this meant that each questionnaire had to be printed in several languages.

With the assistance of Malayan Railways a pilot survey was conducted in January 1969 using a 10 page questionnaire printed in 5 languages: romanised Malay, Jawi (Malay written in Arabic script), Chinese, Tamil (the main Indian language) and English. Experience gained from this survey was used to revise the structure and wording of the basic In-transit Survey questionnaire. English language copies of the final versions of the car and railway travel questionnaire are given in Appendix 2a.[1] As distributed to travellers, the In-transit Survey questionnaire consisted of (a) an introductory letter in Malay, Chinese and English setting out the purpose of the survey and requesting the traveller's assistance, (b) Malay, Chinese and English versions of the questionnaire, each covering two sides of a single foolscap page and (c) a reply paid envelope to facilitate return of the completed questionnaire.[2]

The physical distribution of questionnaires was designed so that each one was handed to a traveller about to commence an inter-city journey or while that journey was actually in progress. Car, taxi and motorcycle travellers were given questionnaires at the Selim River Toll House (72 miles north of Kuala Lumpur on the main north-south highway). Additional surveys of motorists were carried out from the Customs

1. Questionnaires distributed to persons travelling by air, bus, motorcycle and taxi differed only in minor details from the car and railway versions enclosed.
2. None of the respondents to the pilot survey used the Jawi or Tamil scripts and so to save expense and to reduce the bulk of the "package" distributed, these languages were omitted from the final In-transit Survey questionnaire.

checking station at the Johor Baharu end of the causeway linking Malaysia to Singapore and from the ticket booths leading on to the Georgetown-Butterworth vehicular ferry. Questionnaires were distributed to air and bus passengers at the airport and bus terminals in Kuala Lumpur. Railway guards distributed questionnaires to passengers on trains departing from Butterworth, Kuala Lumpur and Singapore. Appendix 2b provides details on the administration of these surveys and on the response rates achieved.

It is well recognised that surveys depending on self-administered questionnaires result in relatively low response rates.[1] The technique was adopted for this study as it seemed to offer the only practicable way of obtaining accurate information on the factors affecting the choice of mode for an inter-city journey. Nevertheless the response rate actually achieved (an average of 8.9 percent over all surveys) fell well below the level that might have been anticipated from the available literature. Some of this shortfall could perhaps be explained by the specific nature of the Malayan context where adult literacy, although undoubtedly high by Asian standards, is still not universal and the problems of questionnaire research are compounded by the existence of several major languages.[2] Questionnaire surveys of any kind are still very rare in Malaysia and in a situation where a huge publicity effort was believed

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1. Oppenheim (1966, p.34) comments that "for respondents who have no special interest in the subject matter of the questionnaire, figures of 40 percent to 60 percent /response/ are typical; even in studies of interested groups, 80 percent is seldom exceeded."
2. Several letters (written in Malay or English) were received from persons who stated that they had not completed their copy of the questionnaire because a Tamil language version had not been provided.

essential to encourage (and, at times, enforce) response to the enumerator administered schedule for the 1970 Census of Population it is not surprising that a self-administered survey should be treated with suspicion.[1]

It is also apparent that the context of an inter-city journey itself is not likely to encourage response to a questionnaire survey. Not everyone travels with pen or pencil immediately at hand and even if writing equipment was available a moving vehicle does not provide the best of conditions for filling in a questionnaire. Even if the survey caught the traveller's interest and the questionnaire was put aside for later completion the stress of arriving at a destination and disembarking from the vehicle could easily result in the form being mislaid or lost. Once the traveller was removed from his journey and became immersed once again in the cares of everyday life any stimulus to answer questions about "why you chose to travel by this mode of transport" would probably disappear rapidly. It is likely, therefore, that the responses obtained from the In-transit Survey depended (even more than usual in questionnaire surveys) on the mood, interest and circumstances of individual passengers.

Despite the very low response rate actually achieved it was necessary to further reduce the "study population" to ensure that all questionnaires analysed (a) dealt with a defined "inter-city" journey and (b) contained valid responses

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1. See, for example, Straits Times (Kuala Lumpur) June 29 and July 13, 1970; Malay Mail (Kuala Lumpur) September 9, 1970.

to at least the choice context and mode descriptors questions. Only 45 percent of the questionnaires returned were considered valid for further analysis.

The data available to this study cannot be regarded as representative of inter-city travellers in Malaya or of travellers on any one route or mode. Furthermore there is every possibility of a pronounced bias toward the opinions of the more interested, more educated travellers and, perhaps, towards those of people dissatisfied with available transport services. There are, of course, no alternative sources of data on the personal characteristics of inter-city travellers but examination of the profile of respondents to the In-transit Surveys (Appendix 4) fails to reveal any evidence of gross bias in the sample.[1] In particular it can be noted that lower status occupations and lower income levels are well represented. On the face of it the most obvious bias would seem to be the low proportion of female respondents. Part of this bias can be explained by the tendency of persons distributing questionnaires to give a form only to the "husband" when a family group appeared to be travelling together. Furthermore data presented on mode-choice reasons and mode disadvantages in Chapter Four do not support the suggestion that the results might be distorted by a large number of responses from persons dissatisfied with

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1. The only known way of obtaining objective data on the characteristics of travellers in Malaya arose during the 1970 Census of Population. Persons travelling by train services that would be en-route at midnight on August 24th were interviewed by census enumerators in the travel vehicle. The Department of Statistics was not prepared to make the census schedules collected in this way available for special tabulations.

particular transport services.[1]

Clearly, the data available from the In-transit Surveys would not support a substantive study of travel patterns in Malaya. Yet a first step has been taken toward the provision of information about mode-choice decisions that can be so useful to transport operators and planners but which they rarely have available. More important to the immediate objectives of the present study is that the In-transit Survey provided data vital to the setting up and testing of an empirical model of individual mode-choice decisions.

2.3.2 Mode Image Survey

As it sought to gather information on a simulated, rather than a real, mode-choice decision the Mode Image Survey was free of some constraints that affected the In-transit Survey. In particular it did not have to be printed in several languages or kept short and simple to ensure even a minimal response rate. The main objective in the administration of the Mode Image Survey, then, was to obtain a large number of responses from a wide range of people. Attention was therefore concentrated on making contact with relatively "formal" groups of people so that questionnaires could be distributed "in bulk" with minimal chances of "wastage".

The Mode Image questionnaire was organised around the semantic differential (Appendix 3a). It emphasised that specified modes of transport were to be judged "according to

1. A total 1425 mode-choice reasons were analysed and 1287 mode disadvantages (a maximum of five of each from any one respondent.

your ideas about them for long distance travel ..." and presented semantic differential formats for each of the 21 scales (mode attributes) selected from a preliminary analysis of mode-choice reasons and mode disadvantages data reported in Chapter Four.[1] Information was also sought on attribute importance, mode qualities that respondents regarded as important but which had not appeared in the list and on rankings of modes in order of preference for a specified journey.[2] Data on the personal characteristics of the respondent and his (or her) travel experience were also collected.

Malay and English language versions of the Mode Image questionnaire were prepared but very few of the Malay language ones were actually used. Administrative details on the distribution of the Mode Image questionnaire are given in Appendix 3b.

As was the case with the In-transit Survey, the data obtained from the Mode Image Survey can in no way be taken to represent all inter-city travellers (actual or potential) in Malaya. Certainly there was a lower proportion of respondents in the professional and managerial occupations than might have been expected (Appendix 4). The mode images described in Chapter Six, therefore, do not necessarily match the perceptions of a true random sample. In the case of Chapter Seven, however, the fact that the data are not

1. A seventh mode, railcar, was included in the questionnaire but was later omitted from the defined set of "inter-city modes".
2. As very few responses were obtained, the information on "additional mode qualities" has not been analysed in this study.

representative is of lesser importance as the analysis focusses primarily on how well the mode preferences of an individual respondent can be predicted from measurements made of his mode images.

2.4 Data Analysis

Analysis of the data collected by the In-transit and Mode Image Surveys was carried out in four stages. The first, reported in Chapter Three focusses on the choice context as recognised by respondents. Three "sets" of modes; possible, practicable and impracticable (possible but not practicable) are described in aggregate and then examined to see if the modes included in a particular set were related to the characteristics of the respondent or of the journey reported. Mode "combinations" are used to gauge how the modes contained in a particular set varied from one respondent to another.

Mode-choice reasons and mode disadvantages are subjected to analysis in Chapter Four. The distribution of responses among the six modes surveyed is set out before seeking the extent to which the use of particular reasons or disadvantages was related to the characteristics of the respondent or the journey. In a final section of this chapter the reasons and disadvantages are combined to form mode descriptors and so help select the adjective scales required for the semantic differential instrument.

Data collected by the Mode Image Survey are first analysed in Chapter Five. Brief attention is paid to the "irrelevant scale" responses before summary mode images are defined in terms of the mean and standard deviation of the ratings given for each scale. Multivariate analysis of variance is then used to examine the extent to which the summary image for a given mode was distinct from, or similar to, the summary image for any other mode. The same procedure also helped identify the main sources of variation within the summary image for each mode. Data from the In-transit Survey are used in a final section of this chapter to assess the accuracy of respondents' knowledge of transport modes in terms of estimates made of the time, cost and distance of their journeys.

A simple numerical model has been designed to use the mode image data reported by any given respondent in an attempt to predict the mode preference rankings provided by that same respondent. Chapter Six summarises results obtained by operating that model and goes on to consider a number of logical refinements to it. The results obtained from these various models are examined to see if the degree of success achieved in predicting the preference rankings of any one respondent was related to the personal characteristics of that respondent or to the structure of his (or her) responses to the Mode Image questionnaire.

The study is concluded in Chapter Seven with a critical review of the basic conceptual model and the way it was made operational and tested. At each stage the discussion highlights important lines for future research.

CHAPTER THREE: THE CONTEXT OF THE MODE-CHOICE DECISION

Classical approaches to the explanation of behavioural patterns assume that actors have complete and accurate knowledge of all the various courses of action available in any given situation. In recent years some studies have introduced "non-economic" factors in an attempt to render analyses of human behaviour more realistic but they still tend to assume that the actor is fully aware of all courses of action and that all of these are evaluated in the decision process. The current surge of interest in the behavioural approach to human geography has brought wider recognition of the notion that decision-makers are not necessarily aware of all potential alternatives and of the effect that limited awareness could have in constraining resultant behaviour.[1]

There are two main areas in human geography where the definition of the subjective choice context has received attention. Hazard and resource management studies have sought to identify the "practical range of choice of adjustment" perceived by resource managers (G.F. White, 1961, 1964, 1974; Kates, 1962; Sarrinen, 1966; Wong, 1969). In general, however, these studies do not make systematic

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1. Dicken, for example, has written
   "The section of this total environment about which information signals are received and interpreted constitutes the behavioural environment or action space and it is this, and only this, which is relevant to purposive behaviour. Phenomena, places or events outside the behavioural environment have no relevance to, and no influence upon, conscious decision making." (1971, p.428)

   Similar points have been made by Clark (1950), Kirk (1963), Thompson (1966), Haynes (1969) and Pocock (1971).

measurements of the images held of the alternatives recognised. Research into intra-urban migration has developed the concept of "awareness space" defined by Brown and Longbrake as

> "that set of locations within the urban area about which the migrant possesses some knowledge ..." (1969, p.171)

Other authors have preferred terms like "action space", "activity space" or "mental map" for essentially the same idea.[1] Attempts to provide a meaningful operational definition for the concept have tended to focus on respondents' ratings of their familiarity with sub-areas of the city in terms of "how well they knew their way around both minor and major streets".[2] As knowledge is derived from both indirect sources (communications from mass media and acquaintances) and direct experience this operational definition has moved away from the basic notion of "awareness space".[3] One can also question the use of fixed areal units as the framework for the collection of familiarity ratings. Do people really organise their knowledge of urban space into identical suburban units? Clearly, there are a number of problems to be solved before we can hope to adequately measure an individual's awareness of spatial alternatives. There can be no doubt, however, that workers in these two fields at least regard knowledge of the alternatives actually considered

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1. See McCracken (1975) for a brief review.
2. Donaldson and R.J. Johnston (1973) p.47. Horton and Reynolds (1971) used a similar methodology.
3. To be precise, the studies mentioned (Donaldson and R.J. Johnston, 1973; Horton and Reynolds, 1971) were concerned with "mental map" and "action space" respectively but they both viewed the data obtained as indices of potential spatial behaviour.

by actors as essential for a clear understanding of the decision processes that generated geographic patterns.[1]

The present chapter investigates the context of the mode-choice decision for inter-city travel in Malaya in terms of the modes that travellers viewed as either "possible" or "practicable" alternatives for their particular journey. Later chapters then go on to examine in some detail the knowledge that travellers had of these various modes. The data analysed here were obtained from two questions in the In-transit Survey questionnaire (Section 2.2.3.1). The set of "possible modes" was defined for each respondent by the replies to the question "Do you know of any other ways of travelling between those two places?" The query "What other methods of transport could YOU have used for this trip?" defined the set of "practicable modes".[2] A third set, "impracticable modes", was derived from these data by including only those modes that were in the "possible mode" set but not in the "practicable mode" set. These three aspects of the mode-choice context are analysed separately. Attention is given, in each case, to the frequency with which modes were reported, the number of modes mentioned by any one respondent and the possibility that particular modes occurred in combination in the choice sets. An investigation is also made of the extent to which the inclusion of a mode in a

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1. The "awareness" stage plays a prominent role in diffusion of innovation theory but in general this refers to the potential adopter's awareness of a single innovation rather than several competing alternatives.
2. In both cases, of course, the travel mode was inserted into the responses before analysis started.

choice set was related to the personal characteristics of the respondent or to the circumstances of his journey.

3.1 The "Possible Mode" Set

Nineteen different modes of passenger travel were recognised by the survey respondents as possible methods for inter-city travel in Malaya. Some notable features emerge from the tabulated results (Table 3.1). Very few travellers reported the possibility of multi-mode journeys; less than one half of one percent suggested using a particular mode for only part of a journey. The responses also identified several modes that certainly exist as possible ways of travelling but are apparently rarely considered for inter-city trips. One surprising feature of this group (walking, hitch-hiking, bicycle, lorry, helicopter and oxcart) is that walking was considered a possible alternative more frequently than hitch-hiking.

Coastal ship, railcar and motorcycle occupy a broad middle range of "awareness". The remaining modes (aeroplane, taxi, car, bus and train) were mentioned with almost identical frequencies showing that some 83 to 86 percent of the respondents were aware of these methods of travel. Such a remarkable coincidence in the frequencies with which these five modes were mentioned suggests that they represent a common choice context for the great majority of the travellers studied here. This is not, in fact, the case. Table 3.2 indicates that only 17 percent included five modes in their possible mode set and these need not have been the five main modes. The table reveals a considerable range in

TABLE 3.1 Possible Modes for Inter-City Travel: Frequency of Mention

Possible Modes	All Surveys No.	All Surveys Percent[a]	Survey Travel Mode: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			percentage[a]					
Aeroplane	426	85	100	74	88	67	85	77
Bus	416	83	73	100	88	67	92	73
Car	422	85	87	65	100	67	69	79
Motorcycle	267	54	40	46	74	100	46	44
Taxi	424	85	77	80	94	100	100	82
Train	431[b]	86	79	74	89	67	92	100[b]
Railcar	137	27	26	16	53	-	54	-
Coastal Ship	61	12	17	2	13	-	15	15
Walk	17	3	2	-	6	-	-	4
Hitch-hike	10	2	1	-	3	-	-	4
Lorry or Van	7	1	2	-	1	-	-	3
Bicycle	6	1	-	-	3	33	-	-
Helicopter	3	1	-	1	1	-	-	1
Ox cart	1	‡	-	-	1	-	-	-
Part by Ship	2	‡	2	-	-	-	-	-
Part by Train	2	‡	-	1	1	-	-	-
Part by Bus	1	‡	-	-	1	-	-	-
Part by Railcar	1	‡	-	-	1	-	-	-
Part by Taxi	1	‡	-	1	-	-	-	-
Total frequency	2,635		557	441	1,002	15	72	548
Number of respondents	499		110	96	163	3	13	114

‡: less than 0.5 percent.

a: Percentages indicate the proportion of respondents in each survey group that mentioned a given mode.

b: Responses from the questionnaire administered to train passengers did not distinguish passengers' awareness of train and railcar. The overall frequency of mention of railcar is therefore underestimated by an unknown amount. Railcar was not defined as one of the six "inter-city" modes and so this does not affect the following analyses.

TABLE 3.2 <u>Size of the Possible Mode Set (All Modes)</u>

Number of modes in the possible mode set	All Surveys No.	All Surveys Percent[a]	Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			Survey Travel Mode percentage[a]					
1	14	3	1	9	2	-	-	1
2	48	10	11	13	6	-	-	13
3	31	6	10	4	2	-	-	11
4	50	10	15	9	3	33	38	12
5	84	17	19	22	9	33	15	22
6	143	29	24	34	31	33	8	28
7	91	18	13	7	33	-	31	11
8	27	5	5	1	10	-	8	3
9	9	2	4	-	3	-	-	-
10	2	†	-	-	1	-	-	-
Total number of modes mentioned	2,635		557	441	1,002	15	72	548
Total number of respondents	499		110	96	163	3	13	114
Mean size of possible mode set	5.3		5.1	4.6	6.1	5.0	5.5	4.8

†: Less than 0.5 percent.
a: Percentages indicate the proportion of respondents within each "size" group. Because of rounding percentages do not always sum to 100.

the number of modes that entered into the first stage of the mode-choice process. It seems to provide strong evidence against any suggestion that the travellers were uniformly aware of all possible modes or even of the important ones. The tabulation might, however, be a little misleading as the form of the questionnaire may have introduced some bias into the results as presented. Responses to the question "Do you know of any other ways of travelling between those two places?" were invited on a partially constrained format.[1] When alternatives are provided for easy checking as here there is always the possibility of some over-estimation of the true responses through auto-suggestion. Conversely, responses concerning modes not actually provided on the form might conceivably be under-estimated. To ensure maximum comparability for the responses to this particular question and also to standardise the bases for further analysis the remainder of this section will be concerned only with the six "inter-city" modes of transport. These six - aeroplane, car, bus, train, taxi and motorcycle - were all, in 1970, available to travellers for journeys between all pairs of the urban nodes defined as cities for the purposes of this study.[2] Thus there is no bias introduced into further investigations of the possible mode sets of respondents because one of the modes was not a viable alternative for some particular inter-

1. See Appendix 2a.
2. This is not to say that each mode was available for direct journeys between all pairs of cities. Travellers by train from Kuala Lumpur to Kota Baharu, for example, must go via Gemas in Negeri Sembilan.

city route: the analysis examines varying cognitions of this common set of available modes.

Redefining the set of objectively available modes in this fashion necessarily alters the tabulations of the reported possible mode sets. Table 3.3 retains evidence of a considerable range in the sizes of the possible mode set but recalls the earlier suggestion of a common mode-choice context comprising the five main modes. Seventy per cent of the respondents were aware of five or all six of the "inter-city" modes: only 18 persons believed that they had no choice beyond their actual travel mode. The actual configuration of these possible mode sets can be investigated in terms of the mode combinations that occurred within them: that is, the modes that went together in travellers' cognitions of the mode-choice context.[1] Combinations that were cited by more than 10 respondents are set out in Table 3.4. Two main features emerge from this table. First: despite the dominance of the two main combinations, the possible mode sets are clearly composed of a considerable number of different combinations - 42 at this stage of the analysis. Second: of the 120 respondents who reported a possible mode set containing five modes (Table 3.3) 95 or 79.1 per cent were not aware of motorcycle as a possible mode on the route they were travelling. In fact 232 of the travellers did not include motorcycle in their possible mode sets. Even before considering the practicable mode sets this result goes a long way towards an explanation of the

1. Appendix 5 sets out the computational procedure used to identify these combinations.

TABLE 3.3 Size of the Possible Mode Set ("inter-city" modes only)

Number of modes in the possible mode set	All Surveys No.	All Surveys Percent[a]	Survey Travel Mode percentage[a]: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
1	18	4	2	12	2	-	-	1
2	48	10	12	10	5	-	-	15
3	32	6	11	4	3	-	8	9
4	55	11	14	12	3	67	39	15
5	120	24	27	27	20	-	15	25
6	226	45	35	35	66	33	39	35
Total number of modes mentioned	2,386		502	421	868	14	63	518
Total number of respondents	499		110	96	163	3	13	114
Mean size of possible mode set	4.8		4.6	4.4	5.3	4.7	4.8	4.5

a: Percentages indicate the proportion of respondents within each "size" group. Because of rounding percentages do not always sum to 100.

TABLE 3.4 Mode Combinations in the Possible Mode Set ("inter-city" modes only)

Mode Combinations[a]	All Surveys No.	All Surveys Percent[b]	Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			Survey Travel Mode percentage[b]					
A, B, C, M, T, Tr	226	45	35	35	66	33	38	35
A, B, C, T, Tr	95	19	24	21	15	-	15	19
A, B, T, Tr	14	3	3	5	-	-	23	3
A, C, T, Tr	13	3	5	-	1	-	8	4
A, C	11	2	8	-	1	-	-	-
B	11	2	-	11	-	-	-	-
A, Tr	10	2	2	-	-	-	-	7
35 other combinations (each recorded fewer than 10 times)								
One mode	7	1	2	-	2	-	-	1
Two mode	27	5	2	10	4	-	-	8
Three mode	32	6	11	4	3	-	8	9
Four mode	28	6	6	6	2	67	8	8
Five mode	25	5	4	6	5	-	-	6
Total number of respondents	499		110	96	163	3	13	114

a: Modes: A - Aeroplane; B - Bus; C - Car; M - Motorcycle; T - Taxi; Tr - Train.
b: Percentages indicate the proportion of respondents in each category. Because of rounding percentages do not always sum to 100.

negligible role of the motorcycle in Malayan inter-city travel.[1] Nearly half of the study group did not think of it as a possible mode for such journeys.

Returning to Table 3.3 it can be noted that the summary results for all surveys taken together are but a poor reflection of the results for individual surveys. A full two-thirds of the car travellers recognised the full range of choice whereas the proportion dropped to slightly more than one-third for bus and aeroplane passengers. Furthermore, respondents who considered that they had no choice of mode beyond the one they were actually using were a particularly notable feature of the bus survey. The mean size of the possible mode set accordingly varies from a maximum for car travellers to the minimum revealed by bus passengers. These observations suggest possible socio-economic differentials in the cognition of the mode-choice context. The remainder of this section examines this hypothesis.

On *a priori* grounds alone it is possible to suggest a considerable number of variables that could influence an individual traveller's awareness of possible modes of transport for journeys along a given route. Specifically these variables would reflect the propensity for a person to

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1. No comprehensive information is available on the roles of the various modes in inter-city travel within Malaya. Results from an origin-destination survey conducted in September 1970 indicated that motorcycles made up only 5.2 percent of all motorcycles, cars and taxis leaving Kuala Lumpur on journeys of 101 miles or more (Valentine, Laurie and Davies, 1971). The author's comparison of information from a Yunit Peranchang Jalan (Highway Planning Unit) survey at Tanjong Malim in September 1969 with manuscript data from air, rail and bus authorities showed that motorcyclists contributed less than one percent of the travel between Ipoh and Kuala Lumpur (Appendix 1).

have a greater or lesser amount of information about the transport system. Most of them would belong to one or the other of two general groups: (a) the personal characteristics of the individual such as age, sex, occupation and income that would provide approximate indices to a person's general state of knowledge of his environment and (b) the actual travel experience of the individual which would represent specific knowledge gained of the transport system itself. A third set of variables defined the actual survey journey though it was expected that these would be more relevant to the perception of alternative practicable modes than to any awareness of possible modes. For this analysis 21 variables were operationally defined and information on each was sought by the In-transit Survey (Table 3.5; Appendix 2a). Contingency tables were constructed for each of these variables setting out the modes considered to be possible alternatives against a particular personal or travel characteristic of respondents. The null hypothesis examined was that the selected variables have no apparent influence on the inclusion of a given mode as a possible alternative: that each contingency table did not differ significantly from the pattern expected if the awareness of modes was, in fact, independent of that particular variable (Blalock, 1960, p231; Siegel, 1956, p105). As the variables were measured on both nominal scales (transport modes, ethnic community, occupation) and ordinal scales (income, age, travel experience) chi-square is the logical method for measuring the degree of the relationship present in these contingency tables. However the nature of the data precludes its use as a test of the

TABLE 3.5 Differentiating the Choice Context: Operational Definition of Variables

Variable	Operational Definition
A) Personal Characteristics	
1. Sex	male; female
2. Age	six age groups: 0-19; 20-29; 30-39; 40-49; 50-59; 60+
3. Income	seven income groups (household income per month in Malaysian dollars): 0-150; 151-300; 301-500; 501-750; 751-1,000; 1,001-1,500; 1,501+
4. Occupation	eight occupation groups:[1] Professional and Technical; Administrative and Managerial; Clerical; Sales; Service; Agriculture, Forestry and Fishing; Production Workers and Labourers; Not Economically Employed.
5. Ethnic Group	five communities: Malay (including Malaysian aboriginal groups and Indonesians); Chinese; Indian (including Pakistanis and Ceylonese); European and Eurasian; Other Asian (i.e. Thai, Japanese).
6. Car Ownership	two categories: own or have regular use of a car; do not own a car.
7. Motorcycle Ownership	two categories: own or have regular use of a motorcycle; do not own a motorcycle.
B) Travel Experience[2]	
8. Experience of the survey travel mode	seven experience categories: never used this mode; 1-2 trips between towns; 3,4 or 5 trips; 6 to 10; 11 to 20; 21 to 50; more than 50 trips between towns.
9. Total travel experience	an estimate of the respondents total travel experience computed from reported experience of trips between towns for each of the six main modes and measured as for variable 8.
10. Travel experience by air	as for variable 8.
11. Travel experience by bus	as for variable 8.

1. These categories were coded according to the Dictionary of Occupational Classification, Malaysia (Ministry of Labour, 1968).
2. The question was phrased in terms of trips between towns because it was felt that this would cause less confusion than "between cities" (Kuala Lumpur, the capital of Malaysia, was not officially designated a "city" until February 1st, 1972). The travel variables can therefore be taken only as an approximation to experience of inter-city travel as defined in this study.

TABLE 3.5 (contd)

12. Travel experience by car	as for variable 8.
13. Travel experience by motorcycle	as for variable 8.
14. Travel experience by taxi	as for variable 8.
15. Travel experience by train	as for variable 8.
C) <u>Survey Trip Situation</u>	
16. Travel Mode	the mode being used by the respondent when he received the In-transit Survey questionnaire: car; train; bus; aeroplane; taxi; motorcycle.
17. Travel Route	the inter-city route being traversed by the respondent when he received the In-transit Survey questionnaire (routes were defined irrespective of the direction of travel): Kuala Lumpur - Ipoh; Kuala Lumpur - Penang; Kuala Lumpur - Singapore; Kuala Lumpur - Alor Setar; Penang - Singapore; Kuala Lumpur - Kota Baharu; Kota Baharu - Singapore; Penang - Ipoh; Penang - Alor Setar; Ipoh - Singapore.
18. Trip Purpose	multiple purposes codes:[1] work or business; family event; non-work conference; holiday; family event and holiday; work and non-work conference; study; personal business; family event, holiday and shopping; other.
19. Trip payment	
(a) Source of payment	<u>Air, bus, taxi and train travellers only</u>: three categories; self; friend or relative; other.
(b) Ownership of travel vehicle	<u>Car and motorcycle travellers only</u>: three categories; self; friend or relative; other
20. Class of travel	(a) <u>Train travellers only</u> (i) First class; second class; third class. (ii) Sleeper; non-sleeper. (b) <u>Air travellers only</u>: first class; economy class.
21. Size of travel group	number of people travelling together: 10 categories; 1 person; 2 people; 3; 4; 5; 6; 7-9; 10-14; 15-19; 20 and over.

1. Multiple responses were accepted from the trip purpose question. It was therefore necessary to reduce them to a single index for each respondent so that trip purpose could be cross-tabulated against the three choice sets. This index (multiple purpose code) was derived by (a) grouping the trip purpose responses into 13 broad categories and (b) identifying "combinations of trip purpose categories" by the same procedure that was used to define mode combinations (Appendix 5). Only those combinations that occurred five times or more have been included separately in the contingency table analyses. The remaining combinations (12.2 percent) were reclassified under the multiple purpose code "other".

statistical significance of these relationships as the chi-square test requires independent observations (Siegel, 1956, p109). The present data consist of from one to six values (modes) for each respondent: individual values are, therefore, hardly independent. The varying number of values per respondent also rules out the possibility of using tests of "k" related samples (Siegel, 1956, Chapter 7). It will be possible to measure only the degree of association present in the contingency table and then rank the variables in order of their apparent influence. Cramer's V^2 is used for this purpose as it provides an index of association comparable across tables of different sizes.[1] Table 3.6 sets out the results of this analysis.

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1. $$V^2 = \frac{\chi^2}{N \text{ Min } (r-1,\ c-1)}$$

where N = total observed frequency
r = number of rows in the contingency table
c = number of columns in the contingency table

V^2 varies between 0.0 (no relationship) and 1.0 (perfect relationship). See Blalock, 1960, p.230. The interpretation of these analyses is aided by an examination of the relative contribution that each cell of the contingency table made to the chi-square value and hence to the value of V^2. As

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{ij} - E_{ij})^2}{E_{ij}},$$

each value of $$\frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

(hereafter referred to as a chi-square "component") indicates the extent to which the observed frequency (O_{ij}) deviates above or below the expected frequency (E_{ij}) derived from the hypothesis of no relationship between the two variables. Relatively large chi-square "components" are used to identify the particular values of the two variables that contribute most to the overall relationship.

TABLE 3.6 Differentiating the Choice Context: Possible Modes

Variable	Cramer's V^2	Rank
A) Personal Characteristics		
1. Sex	.001	10=
2. Age	.001	10=
3. Income	.001	10=
4. Occupation	.001	10=
5. Ethnic Group	.002	7=
6. Car Ownership	.003	4=
7. Motorcycle Ownership	.001	10=
B) Travel Experience		
8. Travel Mode Experience	.001	10=
9. Total Travel Experience	.001	10=
10. Travel by Air	.001	10=
11. Travel by Bus	.001	10=
12. Travel by Car	.001	10=
13. Travel by Motorcycle[a]	.028	1
14. Travel by Taxi	.001	10=
15. Travel by Train	.001	10=
C) Survey Trip Situation		
16. Travel Mode	.003	4=
17. Travel Route	.003	4=
18. Trip Purpose Code	.005	2=
19. Trip Payment	.001	10=
20. Class of Travel		
(a) Train (i) Class[b]	.005	2=
(ii) Sleeper[b]	.002	7=
(b) Air[c]	.002	10=
21. Size of Travel Group	.001	10=

Median V^2:	
All Variables	.001
Personal Characteristics	.001
Travel Experience Variables	.001
Survey Trip Situation	.0025

a: Only 16 respondents.
b: Only 114 respondents.
c: Only 110 respondents.

It is immediately apparent that the variables tested reveal only exceptionally weak relationships with the modes cited as possible alternatives.[1] Such a conclusion is not surprising. Although the attempt was made to differentiate the knowledge travellers held of the transport system in terms of their personal characteristics and travel situations, the element of knowledge was defined only at the highest level of generality: awareness or ignorance of a particular mode. The surveyed travellers were certainly not equally informed of the choice context for inter-city movement but, insofar as the variables tested indicated no consistent relationships, the differences between the respondents can be best described as random.

3.2 The "Practicable Mode" Set

Redefining the choice context in terms of the practicable mode set makes little difference to the number of different modes considered (only two of the part-journey modes no longer appear) but it does reduce the overall number of alternative modes reported by the survey respondents quite substantially: 2635 possible modes become 1677 practicable

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1. The strongest relationship ($V^2=0.028$) was found in conjunction with the travel experience variable "travel by motorcycle". This variable was measured for only the 13 taxi and 3 motorcycle travellers.

modes (Table 3.7).[1] Clear differences in the relative practicability of the major modes are also revealed. Train and car were rated as practicable alternatives by 69 and 67 per cent respectively of the respondents. Aeroplane and taxi were not far behind but bus was practicable for less than half of these travellers and motorcycle found favour with very few indeed. It must be remembered, however, that these summary ratings are partly a function of the number of responses to each survey. The high "practicability" of car is undoubtedly related to the fact that this mode had by far the greatest number of survey respondents, each of whom obviously rated car as a practicable alternative. If the ratings are standardised by assuming an equal number of responses to each survey and no change in the rating of modes within a sample, Table 3.8 is obtained. Possible distortion

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1. In the course of defining the impracticable mode set it was discovered that 31 (6.2 percent) of the 499 respondents had reported practicable modes which had not appeared among their possible modes. These inconsistencies account for 46 (2.7 percent) of the total number of practicable modes mentioned. There is no evidence as to whether an inconsistency arose because (1) a mode was mistakenly excluded from the possible mode responses or (2) a mode was inadvertently included with the practicable mode responses. Nor is there any significant bias to one mode or another.

Practicable modes that were not reported as possible	Frequency
Air	8
Bus	5
Car	8
Motorcycle	9
Taxi	9
Train	7
Total	46

Consequently the data have not been adjusted to remove any such inconsistency. Nevertheless the problem should be noted.

TABLE 3.7 Practicable Modes for Inter-City Travel: Frequency of Mention

Practicable Modes	All Surveys No.	All Surveys Percent[a]	Survey Travel Mode percentage[a]: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
Aeroplane	318	64	100	47	58	33	46	54
Bus	243	49	20	100	37	67	77	46
Car	335	67	61	44	100	-	54	49
Motorcycle	58	12	3	18	11	100	15	13
Taxi	284	57	25	70	64	100	100	61
Train	344	69	36	75[c]	64	67	85	100[b]
Railcar	65	13	5	10	27	-	38	-
Coastal Ship	15	3	2	1	4	-	-	5
Walk	4	1	-	2	-	33	-	1
Hitch-hike	3	1	-	-	1	-	-	2
Lorry or Van	2	†	-	1	1	-	-	-
Bicycle	2	†	-	1	1	-	-	-
Helicopter	1	†	-	1	-	-	-	-
Part by Ship	1	†	1	-	-	-	-	-
Part by Train	1	†	-	1	-	-	-	-
Part by Taxi	1	†	-	1	-	-	-	-
Total frequency	1,677		278	357	598	12	54	378
Number of respondents	499		110	96	163	3	13	114

†: Less than 0.5 percent.

a: Percentages indicate the proportion of respondents in each survey group that mentioned a given mode.

b: Responses from the questionnaire administered to rail passengers did not distinguish passengers' opinions on the practicability of train and railcar. The overall frequency of mention of railcar is therefore under-estimated by an unknown amount. Railcar is not defined as one of the six "inter-city" modes and so this does not affect the following analyses.

c: This figure is greater than the number of respondents that viewed train as a possible alternative (Table 3.1) because of inconsistent responses to the possible mode and practicable mode questions on the In-transit Survey questionnaire (See footnote 1, page 90).

TABLE 3.8 Standardised "Practicability" Ratings[a] ("inter-city" modes only)

Practicable Mode	All Surveys	Aeroplane, bus, car and train surveys only
Aeroplane	56	65
Bus	58	51
Car	51	64
Motorcycle	27	11
Taxi	70	55
Train	71	69

a Cell entries indicate the proportion of respondents that viewed each mode as a practicable alternative and were obtained from Table 3.7 by giving each survey equal weight.

arising from the small number of taxi and motorcycle survey respondents can also be eliminated by omitting those data. The final rating, however, is merely an artificial construct and may bear little relation to the views of a truly random sample of all inter-city travellers in Malaya. No definitive estimate of inter-city modal split is available for Malaya and so there is little value in pursuing the point further. However a second look should be taken at the data of Table 3.7 as it includes all respondents regardless of whether or not they viewed each mode as a possible alternative in the first place.

Table 3.9 presents the relative practicability of the six major modes as a proportion of the number of respondents that perceived each mode as possible. The problem of aggregating the responses from the various surveys again reduces the value of any summary measures of practicability. Within the surveys, however, there is ample evidence of how cognitions of the choice context can serve to limit the range of potential behaviour. This is particularly so with respondents to the air survey. Of the air travellers that viewed bus as a possible mode, only 28 percent considered it practicable. The comparable figure for the practicability of motorcycle was 7 percent.

Turning attention to the sets of practicable modes, Table 3.10 indicates that respondents viewed, on the average, 3.4 modes as practicable alternatives compared with an average 5.3 possible modes. The main feature of this table, when compared with Table 3.2, is that the decrease in set size varies considerably among the survey travel modes. Aeroplane and car

TABLE 3.9 Practicable Modes in Relation to Possible Modes[a]

Practicable Modes	All Surveys	Survey Travel Mode: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
Aeroplane	73	100	61	65	50	45	65
Bus	57	28	100	41	100	83	60
Car	77	68	65	100	0	67	58
Motorcycle	19	7	36	13	100	33	22
Taxi	65	32	81	67	100	100	74
Train	78	46	92	71	100	92	100

a. Cell entries indicate the proportion of respondents viewing a given mode as possible that also reported the same mode as a practicable alternative.

TABLE 3.10 Size of the Practicable Mode Set (All Modes)

Number of modes in the practicable mode set	All Surveys No.	All Surveys Percent[a]	Survey Travel Mode percentage[a]: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
1	65	13	25	7	13	-	8	7
2	118	24	33	22	17	-	15	28
3	103	21	23	17	25	33	8	18
4	84	17	12	21	9	33	15	30
5	69	14	3	16	20	33	38	11
6	40	8	5	16	8	-	8	5
7	15	3	1	1	6	-	8	2
8	4	1	-	1	2	-	-	-
9	1	†	-	-	1	-	-	-
Total number of modes mentioned	1,677		278	357	598	12	54	378
Total number of respondents	499		110	96	163	3	13	114
Mean size of practicable mode set	3.4		2.5	3.7	3.7	4.0	4.1	3.3

†: Less than 0.5 percent.
a: Percentages indicate the proportion of respondents within each size group. Because of rounding percentages do not always sum to 100.

travellers reported the greatest overall changes with average differences of 2.6 and 2.4 modes respectively, while bus travellers indicated comparatively little change: an average of 0.9 modes. These differences between the possible and practicable mode sets alter little when the sets are redefined in terms of the six "inter-city" modes (Tables 3.3 and 3.11). On the basis of this analysis two general types of respondents appear to emerge from the survey data. Car and aeroplane travellers were better informed of the existence of alternative modes of travel than bus passengers but they viewed fewer of those modes as practicable alternatives for the surveyed journey. It can be argued that these car and aeroplane travellers were somewhat more demanding of transport conditions than the respondents who reported satisfaction with a greater range of alternatives.

Substantial differences between travel modes also occur in the structure of the practicable mode sets. The most frequently mentioned mode combination, the five mode group aeroplane-bus-car-train-taxi, is a major feature of car and bus travellers' reports but is quite unimportant for aeroplane users. Table 3.12 shows the modes which these air-travellers did include in their rather restricted view of the practicable mode choice context. More than half of them (51 per cent) viewed only air or air and car as practicable alternatives while another 15 per cent added train to these two modes. Respondents using the other modes spread over a greater number of mode combinations and tended to include a greater variety of modes within those combinations.

The remainder of this section will be concerned with

TABLE 3.11 Size of the Practicable Mode Set ("inter-city" modes only)

Number of modes in the practicable mode set	All Surveys No.	All Surveys Percent[a]	Survey Travel Mode: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			percentage[a]					
1	68	14	25	9	14	-	8	7
2	120	24	34	21	17	-	15	29
3	111	22	25	18	25	33	23	19
4	94	19	9	23	16	67	8	29
5	71	14	6	18	19	-	38	10
6	35	7	2	11	9	-	8	6
Total number of modes mentioned	1,582		269	339	545	11	49	369
Total number of respondents	499		110	96	163	3	13	114
Mean Size of practicable mode set	3.2		2.4	3.5	3.3	3.7	3.8	3.2

a: Percentages indicate the proportion of respondents within each size group. Because of rounding percentages do not always sum to 100.

TABLE 3.12 Mode Combinations in the Practicable Mode Set ("inter-city" modes only)

Mode Combinations[a]	All Surveys No.	All Surveys Percent[b]	Survey Travel Mode percentage[b]: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
A, B, C, T, Tr	65	13	6	15	18	-	31	9
A, C, Tr	41	8	15	-	10	-	-	6
A, C	38	8	26	-	6	-	-	-
A, B, C, M, T, Tr	35	7	2	11	9	-	8	6
A, C, T, Tr	32	6	3	-	12	-	-	9
A	27	5	25	-	-	-	-	-
C	23	5	-	-	14	-	-	-
A, B, T, Tr	20	4	3	10	-	-	-	6
36 other combinations (each recorded fewer than 20 times)								
One mode	18	4	-	9	-	-	8	7
Two mode	82	16	7	21	12	-	15	29
Three mode	70	14	9	18	15	33	23	13
Four mode	42	8	4	13	4	67	8	14
Five mode	6	1	-	3	1	-	8	1
Total number of respondents	499		110	96	163	3	13	114

a: Modes: A - Aeroplane; B - Bus; C - Car; M - Motorcycle; T - Taxi; Tr - Train
b: Percentages indicate the proportion of respondents in each category. Because of rounding percentages do not always sum to 100.

high-lighting those personal characteristics of travellers and the features of their travel situation that most clearly differentiate the selection of the various modes as practicable alternatives or not. The same procedure as adopted in Section 3.2 will be followed here but there is some difference in the rationale of the analysis. In the previous section the variables were interpreted as indices differentiating respondents in terms of the relative amounts of knowledge they might be expected to hold about the transport system. Designation of a mode as a practicable alternative, however, implies some knowledge of the characteristics of a mode as well as its mere existence and also some degree of evaluation of the "practicability" of that mode for the survey journey. The variables entered into the analysis are therefore taken as indices of the tendency to evaluate a mode as suitable or unsuitable for a given journey. This evaluation process is somewhat more complex than the simple recognition of the physical existence of a mode and so it is not surprising that the personal and travel characteristics of the respondents differentiate the cognition of practicable modes a little more clearly than they do the awareness of possible modes (Table 3.13).

This distinction is very clearly brought out by the relatively high power of the car ownership variable.[1] Inspection of the contributions made by each cell in the contingency table to the chi-square value and hence to the

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1. Travel by Motorcycle again revealed the strongest relationship but as this variable was measured only for 16 taxi and motorcycle travellers the point is not taken further.

TABLE 3.13 Differentiating the Choice Context: Practicable Modes

Variable	Cramer's V^2	Rank
A. Personal Characteristics		
1. Sex	.009	16=
2. Age	.007	19=
3. Income	.018	7
4. Occupation	.010	13=
5. Ethnic Group	.011	12
6. Car Ownership	.046	2
7. Motorcycle Ownership	.021	6
B. Travel Experience		
8. Travel Mode Experience	.010	13=
9. Total Travel Experience	.010	13=
10. Travel by Air	.015	8=
11. Travel by Bus	.007	19=
12. Travel by Car	.009	16=
13. Travel by Motorcycle[a]	.086	1
14. Travel by Taxi	.004	22
15. Travel by Train	.003	23
C. Survey Trip Situation		
16. Travel Mode	.029	4
17. Travel Route	.012	11
18. Trip Purpose Code	.023	5
19. Trip Payment	.013	10
20. Class of Travel		
(a) Train (i) Class[b]	.033	3
(ii) Sleeper[b]	.009	16=
(b) Air[c]	.015	8
21. Size of Travel Group	.005	21

Median V^2:	
All Variables	.011
Personal Characteristics	.011
Travel Experience Variables	.0095
Survey Trip Situation	.014

a. Only 16 respondents.
b. Only 114 respondents.
c. Only 110 respondents.

magnitude of V^2 (chi-square "components") helps interpret this result. Much of the apparent power of the variable is generated by respondents who did not own or have the regular use of a car. It is not surprising that they viewed car as a practicable alternative far less frequently than expected under the hypothesis of no relationship, though there were still 42 "non-owners" who regarded car as practicable.[1] Correspondingly, these travellers considered bus to be practicable much more often than expected.[2] It is also notable that the variables used to index the circumstances of the survey journey tend to differentiate the practicable modes more strongly than the personal characteristics or travel experience variables, though the differences here are only marginal.

Car ownership has been identified as the variable most closely related to the modes viewed as practicable alternatives but it must be admitted that all the relationships calculated are very weak. Although the relationships are a little stronger than those obtained in the analysis of possible modes the strongest is still only $V^2 = 0.086$, a very long way short of a perfect relationship ($V^2 = 1.00$). The surveyed travellers clearly do not have closely comparable views of what constitutes a practicable mode of transport. Yet it is equally apparent that these differing cognitions are not strongly related to the personal characteristics of

1. These respondents presumably thought in terms of borrowing (or hiring) a car or travelling by car as a passenger.
2. Appendix 5b presents the detailed table from which these interpretations were drawn.

the respondent, his travel experience or the nature of his journey.

3.3 The "Impracticable Mode" Set

Given a cognised set of possible modes for a particular journey there are at least two ways in which a mental decision mechanism might operate to redefine the choice context in terms of a set of practicable modes and so make the decision more manageable. One procedure might involve a brief evaluation of each mode to see if it was "suitable" for the journey in question. All of the modes considered suitable would then make up the practicable mode set. Another procedure would invert the mechanism and eliminate those modes considered unsuitable or impracticable.[1] In practice the decision process is likely to involve elements of both procedures. As Section 3.2 looked at the results and correlates of the first mechanism, this section reports a similar analysis of the second; the identification of impracticable modes.

Table 3.14 sets out the frequencies with which each of the six major modes were viewed as impracticable alternatives.[2] As expected motorcycle appears most frequently but not very

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1. Gould (1963), Koopmans (1964), Brown and Longbrake (1969), Brown and Holmes (1971) and Dicken (1971) all refer to this kind of procedure.
2. For each mode the number of mentions as practicable (Table 3.7) plus the number of mentions as impracticable (Table 3.13) does not necessarily equal the number of mentions as possible (Table 3.1). Discrepancies arise from inconsistent responses to the possible modes and practicable modes questions on the In-transit Survey questionnaire. The impracticable modes discussed here were defined as those modes that were reported as possible alternatives but were not regarded as practicable.

TABLE 3.14 Modes Considered Impracticable for Inter-City Travel: Frequency of Mention ("inter-city" modes only)

Impracticable Modes	All Surveys No.	All Surveys Percent[a]	Survey Travel Mode percentage[a]: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
Aeroplane	116	23	-	29	31	33	46	27
Bus	178	36	53	-	52	-	15	29
Car	96	19	28	23	-	67	23	33
Motorcycle	217	43	37	29	64	-	31	34
Taxi	147	29	53	16	31	-	-	21
Train	96	19	43	6	26	-	8	-
Total impracticable modes	850		235	99	332	3	16	165
Total number of respondents	499		110	96	163	3	13	114
Mean size of impracticable mode set	1.7		2.1	1.0	2.0	1.0	1.2	1.4

a: Percentages indicate the proportion of respondents in each survey group that considered the given mode to be impracticable for the surveyed journey. Because of rounding percentages do not always sum to 100.

much more so than bus. Car and train coincide at the other end of the scale as the least impracticable modes. Substantial differences among the travel surveys again appear. Car travellers, for example, viewed motorcycle as impracticable far more frequently than air travellers did. It must be remembered, however, that these ratings depend, in the first instance, on the mode being recognised as an alternative. A glance at Table 3.1 shows that comparatively few of the air travellers did view motorcycle as a possible mode. The difference between car and air respondents on this point reverses and almost disappears when the number of respondents for whom motorcycle was an impracticable alternative is taken as a percentage of the number that cited motorcycle as a possible alternative. Eighty-eight per cent of the car travellers and 93 per cent of the aeroplane passengers who were aware of motorcycle did not view it as a practicable mode of transport (Table 3.15). Apart from possible distortions arising from the small number of respondents to the taxi and motorcycle surveys the table shows a remarkable degree of consistency across the travel modes. The most pronounced differences occur with the cognition of train. More than half of the aeroplane passengers who were aware of train also considered it impracticable; the percentage drops to eight for the bus travellers.

An examination of the mode combinations present in impracticable mode sets reveals that a substantial proportion of respondents did not, in fact, report any impracticable modes (Table 3.16). For these people the possible and practicable mode sets (when defined in terms of the six

TABLE 3.15 Impracticable Modes in Relation to Possible Modes[a]

Impracticable Modes	All Surveys	Survey Travel Mode: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
Aeroplane	27	0	39	35	50	55	35
Bus	43	72	0	59	0	17	40
Car	23	32	35	0	100	33	42
Motorcycle	81	93	64	88	0	67	78
Taxi	35	68	19	33	0	0	26
Train	22	54	8	29	0	8	0

a. Cell entries represent the proportion of respondents viewing a given mode as possible that also viewed the same mode as impracticable. This table is the complement of Table 3.9.

TABLE 3.16 Mode Combinations in the Impracticable Mode Set ("inter-city" modes only)

Mode Combinations[a]	All Surveys No.	All Surveys Percent[b]	Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			Survey Travel Modes percentage[b]					
No impracticable modes	152	30	22	50	22	33	31	34
M	38	8	3	6	15	-	8	4
B, M, T	27	5	7	-	9	-	-	4
B, M	24	5	2	-	10	-	8	4
B, M, T, Tr	20	4	12	-	4	-	-	-
C	19	4	4	3	-	33	8	9
50 other combinations (each recorded fewer than 19 times)								
One mode	39	8	8	7	5	-	23	11
Two mode	71	14	19	20	7	33	8	16
Three mode	51	10	11	7	14	-	8	7
Four mode	40	8	8	6	8	-	8	10
Five mode	18	4	5	-	7	-	-	2
Total number of respondents	499		110	96	163	3	13	114

a: Modes: A - Aeroplane; B - Bus; C - Car; M - Motorcycle; T - Taxi; Tr - Train.
b: Percentages indicate the proportion of respondents in each category. Because of rounding percentages do not always sum to 100.

"inter-city" modes) were identical. Once again variations among the survey travel modes can be noted. Exactly half of the bus travellers viewed all of their possible modes as practicable alternatives also, but the proportion drops below one quarter for the car and air travellers. This result follows from the points made in the previous section concerning the relative amounts of change between possible mode and practicable mode sets for car and air travellers on the one hand and for bus travellers on the other. Apart from the predominance of the null or empty set the most notable feature of the impracticable modes combinations is the relatively large number of combinations that occur. Fifty-six of the maximum 64 combinations appear whereas the possible mode and practicable mode sets numbered only 42 and 44 combinations respectively.[1] From this result and from the minor importance of the second impracticable modes combination, it would appear as though the respondents did not consistently associate certain modes as impracticable alternatives.

It does seem, however, that there are stronger relationships between the variables tested and the modes viewed as impracticable than were demonstrated for the cognition of possible and practicable modes. Travel experience by motorcycle is again the most powerful variable but, as before, this

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1. n different objects taken r at a time can be combined in nCr different ways where $nCr = \frac{n!}{(n-r)!r!}$. Six modes taken 1, 2, 3, 4, 5 and 6 at a time can therefore be combined in 6+15+20+15+6+1=63 ways. Including the null set (0 at a time) makes the total number of different combinations 64.

result cannot be considered meaningful (Table 3.17). Among the remaining variables, it is car ownership that most strongly differentiates the impracticable modes. Its V^2 almost doubles in size in comparison with the practicable modes analysis but is still very small. Examination of the chi-square components again shows that much of the power of this relationship is generated by "non-owners" who reported car as an impracticable mode more frequently than expected under the null hypothesis.[1] Variables indexing the situation of the survey trip are also more powerful in differentiating impracticable modes than the personal characteristics or travel experience measures. Again, however, the differences are small and the individual relationships are revealed to be very weak.

3.4 Summary

Respondents to the In-transit Survey provided information on their cognitions of the context of the mode-choice decision that generated the survey journey. Three main conclusions can be drawn from the analysis of this information. First, it is clear that respondents were not fully aware of the objective choice context, even in the simplified form that was adopted here. For all of the journeys analysed the actual range of choice included the six "inter-city" modes; aeroplane, bus, car, motorcycle, taxi and train. Less than half of the study population viewed all six modes as possible alternatives. Furthermore, the respondents differed markedly in terms of the particular

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1. See Table A5.3 in Appendix 5b for the details of this analysis.

TABLE 3.17 Differentiating the Choice Context: Impracticable Modes

Variable	Cramer's V^2	Rank
A. Personal Characteristics		
1. Sex	.014	16
2. Age	.012	20
3. Income	.028	6=
4. Occupation	.020	12=
5. Ethnic Group	.013	17=
6. Car Ownership	.087	2
7. Motorcycle Ownership	.022	10=
B. Travel Experience		
8. Travel Mode Experience	.018	14=
9. Total Travel Experience	.018	14=
10. Travel by Air	.028	6=
11. Travel by Bus	.013	17=
12. Travel by Car	.023	9
13. Travel by Motorcycle[a]	.262	1
14. Travel by Taxi	.007	23
15. Travel by Train	.010	22
C. Survey Trip Situation		
16. Travel Mode	.053	4
17. Travel Route	.020	12=
18. Trip Purpose Code	.058	3
19. Trip Payment	.028	6=
20. Class of Travel		
(a) Train (i) Class[b]	.029	5
(ii) Sleeper[b]	.022	10=
(b) Air[c]	.013	17=
21. Size of Travel Group	.011	21

Median V^2:		
	All variables	.020
	Personal Characteristics	.020
	Travel Experience Variables	.018
	Survey Trip Situation	.025

a. Only 16 respondents.
b. Only 114 respondents.
c. Only 110 respondents.

alternatives recognised. Second, most respondents reported a smaller set of modes that they saw as practicable alternatives for the journey surveyed. That is, some of the modes they recognised were rejected as unsuitable or impracticable for the trip in question. Again there was considerable variation among respondents in terms of the particular modes viewed as either practicable or impracticable. However, the practicability of a particular mode is a more complex notion than simply being aware that it was available on a given route. Practicability implies suitability and, in the case of private transport, capability. Persons who did not own a car, for example, would not be expected to consider car a practicable mode. Evidence of this was presented but, at the same time, there was a number of "non-owners" who did believe car was a practicable alternative for their journey. Other variables that could have an effect on practicability, such as the urgency accorded to the journey, were not investigated. Third, the particular modes that respondents did cite as possible, practicable or impracticable alternatives were only very weakly related to variables that indexed the personal characteristics or travel experience of the individual and the situation of his journey. There was evidence that the trip situation variables generated slightly stronger relationships than either of the other two groups of measures.

Data from the In-transit Survey have shown that travellers were not fully aware of the various modes available for their journeys. Limited awareness of the choice context restricts the range of potential behaviour. Yet the great majority of respondents was aware of more than one alternative mode. Therefore, to be able to undertake a journey, they had to carry out some form of evaluation process to select the mode actually used. Chapter Four discusses the criteria which these travellers used to evaluate alternative modes.

CHAPTER FOUR: MODE DESCRIPTORS

Following the specification of the mode-choice context the focus of the conceptual framework shifts to the processes by which the alternative modes are compared and evaluated so that one mode can be selected for actual use. The intending traveller evaluates the modes seen as viable alternatives in terms of the knowledge or image that he holds of each one. Any attempt to model the mode-choice decision needs, therefore, to be able to measure these subjective images. Discussion of this point in Chapter Two highlighted two crucial aspects of image measurements; (a) the actual criteria on which judgements are based and (b) the relative positions of the alternatives on each of these criteria. Many studies have been concerned with identifying the particular factors that entered into the decisions affecting geographic behaviour.[1] This chapter describes and analyses the criteria (or mode descriptors) used by inter-city travellers in Malaya to evaluate their travel modes. Respondents to the In-transit Survey provided data in the form of the reasons they gave to explain their choice of a mode and the disadvantages that they associated with the use of it.[2] Thus both positive and negative aspects of mode images can be

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1. See, for example, Sommers (1969, 1970, 1971) and Golob (1970) on mode-choice; Campbell and McCargar (1956) and Wachs (1967) on route-choice; Goodwin (1968) and Yeung Yue Man (1970) on consumer behaviour; MacDonald and MacDonald (1968) and Sonnenfeld (1974) on migration decisions; Daly (1968), Boyce (1969), Clark (1970) and Menchik (1972) on intra-urban residential mobility.
2. Section 2.2.3.2.1 gives the actual wording of the questions used.

investigated in terms of the frequency distribution of responses and the combinations apparent among them. Possible relationships between the responses given by any respondent and variables indexing his personal characteristics, travel experience or trip situation are also explored. Following these separate analyses of mode-choice reasons and mode disadvantages, the two sets of responses are combined to generate one list of basic mode descriptors capable of tapping both the attractive and unattractive aspects of travel modes. This list would have been an excellent guide to help select the most relevant descriptors for the semantic differential instrument used to measure mode images. Unfortunately, however, the analyses reported here were not complete by the time the semantic differential had to be finalised and so the selection of scales had to be based on a less rigorous assessment of the data available at the time. The final section of this chapter includes a comparison of the scales actually used with the full list of basic descriptors.

Before any of the analyses could proceed it was necessary to reduce the numerous responses (1425 reasons under 308 different codes and 1290 disadvantages under 387 different codes) to a much smaller number of general categories more amenable to quantitative analysis. This process of amalgamation was accomplished in two stages. An initial grouping of similar statements left 151 categories of reasons and 104 of disadvantages. The final procedure combined these categories into 38 "super-categories" of reasons and 36 of disadvantages.[1] From this point in the study all references to mode-choice reasons or to mode disadvantages concern these "super-categories".[2] Although every care was taken during this procedure of amalgamating the "raw" questionnaire responses the end result can be nothing more than a product of this writer's personal opinion. Usually it was possible to take the responses at face value but in a small number of cases it was necessary to try to infer the intent behind some responses before they could be allocated to a particular category.[3] The main problem came at the second stage when comparatively well-defined groups of reasons (or disadvantages) had to be amalgamated to form more general concepts when they might have legitimately stood by themselves.[4] Nevertheless it is believed that the broad dimensions of passenger transport derived from these responses, do not violate greatly the intentions of the travellers who supplied them. The next two sections examine the mode-choice reasons and mode disadvantages in some detail.

4.1 Mode-Choice Reasons

When a large number of different responses are amalgamated to form a smaller number of more general response

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1. These numbers include, in both cases, a separate category for "no response".
2. Appendix 6 interprets these "super-categories" giving examples of the range of responses included in each.
3. For example, the response "not too fast" was taken to mean a more leisurely, relaxing journey rather than one that did not involve dangerous speeds.
4. References to refreshment facilities, for example, had to be incorporated into a broader category of the general facilities available while travelling.

groups there is always the possibility of creating duplicate responses from the same person. Two mode-choice reasons that, presumably, were intended to be quite separate could, in the amalgamation process, be allocated to the same general category. In the present study the duplicate responses generated in this way amounted to only 6.1 per cent of the total number of mode-choice reasons analysed. This result might be regarded as slight evidence that the amalgamation process has not greatly distorted the following analysis.

Grouping the 1425 initial mode choice responses into 38 general categories derived the distribution presented in Table 4.1.[1] As other modal split studies have found, cost clearly plays a major role in mode-choice decisions.[2] It should be pointed out however that a further grouping of "Travel Time" and "Speed" would just exceed "Cost" in overall frequency of mention. These latter two concepts were deliberately kept separate in this study to see if respondents did recognise the important practical distinction between them. "Flexibility" owes its large number of responses almost entirely to the responses of car passengers although, in relative terms, the category did have some significance for taxi and motor cycle travellers. From the point of view of obtaining an unequivocal explanation of mode-choice patterns, "Convenience" and "Preference" occur with disappointingly high frequencies. Taken together they are

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1. Six of the initial responses were judged to incorporate two distinct ideas. Each of these responses was therefore tabulated in two different categories and so the total number of responses became 1431.
2. See, for example, Hille and Martin (1967), Lansing and Hendricks (1967), Nash and Hille (1968), Paine et. al. (1969).

TABLE 4.1 Mode-Choice Reasons: Frequency of Mention

Mode-Choice Reasons[a]	All Surveys		Survey Travel Mode					
	No.	Percent[b]	Aero-plane	Bus	Car	Motor-cycle	Taxi	Train
			percentage[b]					
Cost	249	17	7	25	18	10	9	19
Travel Time	150	10	26	13	6	10	21	2
Flexibility	142	10	‡	1	26	10	14	2
Convenience	137	10	11	4	17	30	11	2
Safety	112	8	4	13	3	-	-	15
Speed	100	7	16	7	5	10	21	‡
Comfortable Seats	86	6	15	6	2	-	5	4
Relaxing	71	5	8	4	2	-	5	8
Preference	41	3	2	2	3	10	-	5
Scenery	39	3	-	3	2	-	-	5
Own Vehicle	32	2	-	‡	6	20	-	‡
En-route Facilities	30	2	‡	2	-	-	5	6
Timetable	28	2	1	1	‡	-	5	6
Spacious	24	2	-	1	‡	-	-	6
Miscellaneous	19	1	-	3	1	-	-	2
Travel in a group	17	1	-	1	2	-	-	2
Access to mode	15	1	-	3	‡	-	-	1
Taking luggage	13	1	-	-	2	-	2	1
No other possible	13	1	-	-	‡	-	-	4
Cleanliness	11	1	2	1	‡	-	-	-
Decision by others	10	1	3	-	‡	-	-	‡
Meet people	10	1	-	1	‡	-	-	2
Seat Reservations	9	1	-	3	-	-	-	-
Not crowded	9	1	-	2	‡	-	5	‡
Fixed schedule	8	1	-	1	-	-	-	2
Ventilation	7	‡	-	1	‡	-	-	1
Suitable Distance	7	‡	-	-	1	-	-	1
Reliability	7	‡	-	‡	‡	-	-	1
Personal Service	6	‡	2	-	-	-	-	-
Road Quality	5	‡	-	-	1	-	-	-
Waiting	5	‡	-	‡	1	-	-	-
Social Status	5	‡	2	-	-	-	-	-
No Worries	3	‡	-	-	-	-	-	1
Privacy	3	‡	-	-	‡	-	-	‡
Punctuality	2	‡	-	‡	-	-	-	‡
Smooth Ride	2	‡	-	‡	-	-	-	‡
Information	1	‡	‡	-	-	-	-	-
No response	3	‡	-	‡	‡	-	-	-
Total number of reasons	1431		258	296	491	10	44	332
Number of respondents	499		110	96	163	3	13	114
Mean number of reasons per respondent	2.9		2.3	3.1	3.0	3.3	3.4	2.9

‡ Less than 0.5 percent.

a. See Appendix 6a for a fuller interpretation of these category titles.

b. Percentages indicate the proportion of responses that come within each category. Because of rounding percentages do not always sum to 100.

second only to "Cost". A convenience factor has been noted in a variety of studies but there is always some doubt as to exactly what it means.[1] In this case, one might expect it to incorporate some notion of easy access to the travel mode along with a high degree of flexibility in time and route of travel but it is impossible to define the concept more precisely. In this study "Preference" included all unqualified expressions of liking or preference for a particular mode. These two reasons leave a substantial "grey" area in the explanation of mode-choice on the basis of the reasons contributed by the inter-city travellers studied.

Some interesting features emerge from the low frequency end of the summary distribution. Both "Reliability" and "Punctuality" are given little weight in the reported decisions but it is quite understandable that these factors should matter far less in the context of inter-city journeys than would be expected for intra-urban transportation and particularly for the journey-to-work. A reader from temperate latitudes might wonder at the low priority accorded to "Ventilation" in travel decisions under tropical conditions. The point is clearly of minor importance among mode-choice reasons but becomes a major issue when mode disadvantages are considered (Table 4.6). With such a small number of "No Responses" one is encouraged to believe that the question used to generate the mode-choice reasons was easily comprehended and not entirely foreign to the thinking of these travellers. But it does not guarantee that the responses made on the

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1. Or even if it means the same thing to everyone that cites it. See Riley (1970), Yeung Yue Man (1970), R.J. Johnston (1973) and Smith (1974).

questionnaire accurately represent the factors that actually did influence the choice made.

Once again the tabulated results demonstrate substantial differences among the various travel modes. Car travellers, for example, refer to "Flexibility" far more frequently than do train, bus or aeroplane travellers but they give much less weight to "Travel Time" and "Speed" than bus or aeroplane users. Surprisingly, these last two qualities were rarely mentioned by train passengers who seem to have justified their mode-choices in terms of a much wider range of reasons than the other travellers. Only 42 percent of the responses from those using train come under the three most frequently mentioned categories whereas the proportions for car, bus and aeroplane travellers are 61, 51, and 57 respectively. Some of the details presented by the Table are not unexpected. Among the six travel modes,"Cost" was of least significance for air travellers and relatively few respondents justified choices of either aeroplane or car on the grounds of "Safety".

These ratings of the mode-choice reasons on the basis of the frequencies with which they were mentioned assumes that all reasons given by a particular respondent were of equal weight in his mode-choice decision. It was considered highly unlikely that this would, in fact, be the case and so respondents to the In-transit Survey were asked to rank their reasons in order of importance. From these rankings an attempt will be made to derive a more realistic overall rating of the mode-choice reasons. This will be done in two ways. The first rating will include only that reason cited as most important by each respondent. Secondly, an arbitrary system of weights will be used to combine the first <u>three</u> reasons reported on each questionnaire into a single scale of relative importance.[1,2] The results for both of these procedures are set out in Table 4.2. Neither of the two importance rankings differ greatly from that obtained from the overall frequency distribution. Spearman rank correlation coefficients calculated for "overall frequency" against "most important reason" and for "overall frequency" with "weighted importance" were 0.89 and 0.98 respectively.[3] The lower amount of agreement in the case of "most important reason", is reflected by the higher ranks accorded to "Convenience", "Speed", "Own Vehicle", "Timetable", and "Decision made by Others"; and by the lower ranks of "Flexibility", "Relaxing", "En-route Facilities" and "Cleanliness" than shown by the overall frequency of reasons. Remarkably good correspondence was obtained for the "weighted importance" ranks and none of the major reasons shifted more than two rank positions. It must be remembered, however, that the composite importance scale was constructed by means of arbitrary weights which, not least in being constant for all respondents, are probably quite unrealistic.

Before examining possible relationships between the mode-choice reasons given by individuals and the set of personal and travel variables defined in Table 3.5, two further

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1. The questionnaire requested only three reasons in order of importance but many respondents gave more. Up to five reasons per respondent were used in the analyses reported so far.
2. The weights used were: most important reason x 3; second most important reason x 2; third most important reason x 1.
3. Siegel, 1956, pp.206-207. Use of the alternative formula to accommodate tied ranks did not change these coefficients.

TABLE 4.2 Relative Importance of Mode-Choice Reasons

Mode-Choice Reasons	Overall Frequency		Most Important Reason		Weighted Importance	
	Number[a]	Rank	Number[a]	Rank	Number[a]	Rank
Cost	249	1	84	1	472	1
Travel Time	150	2	82	2	343	2
Flexibility	142	3	40	5	251	4
Convenience	137	4	57	3	296	3
Safety	112	5	39	6	218	6
Speed	100	6	52	4	233	5
Comfortable Seats	86	7	12	9=	140	7
Relaxing	71	8	8	13=	111	8
Preference	41	9	12	9=	65	11
Scenery	39	10	12	9=	74	10
Own Vehicle	32	11	19	7	75	9
En-route facilities	30	12	1	26=	47	13
Timetable	28	13	15	8	63	12
Spacious	24	14	6	16=	35	15
Miscellaneous	19	15	9	12	37	14
Travel in a group	17	16	8	13=	33	16
Access to mode	15	17	6	16=	30	17
Taking Luggage	13	18=	3	19=	23	20
No other possible	13	18=	5	18	28	18
Cleanliness	11	20	-	29=	10	27=
Decision by others	10	21=	8	13=	27	19
Meet people	10	21=	-	29=	13	25
Seat Reservations	9	23=	2	22=	14	22=
Not crowded	9	23=	3	19=	15	21
Fixed schedule	8	25	1	26=	12	26
Ventilation	7	26=	2	22=	14	22=
Suitable Distance	7	26=	3	19=	14	22=
Reliability	7	26=	1	26=	10	27=
Personal Service	6	29	-	29=	3	34=
Road Quality	5	30=	2	22=	10	27=
Waiting	5	30=	2	22=	10	27=
Social Status	5	30=	-	29=	5	31=
No Worries	3	33=	-	29=	5	31=
Privacy	3	33=	-	29=	2	36=
Punctuality	2	35=	-	29=	3	34=
Smooth Ride	2	35=	-	29=	4	33
Information	1	37	-	29=	2	36=

a. Excluding "No Response".

aspects of reported reasons should be briefly considered.

1) In the mode-choice situation where various modes are evaluated in the process of making a decision, it might be expected that the reasons given to justify the choice made would incorporate specific references to the rejected, less suitable modes. As Table 4.3 shows this was rarely done by the respondents to the In-transit Survey: only 7.5% of the 1431 responses referred to another mode of transport. Entries in this Table indicate the frequency with which a particular mode was explicitly mentioned as less satisfactory on the given dimension than the selected method of transport. Table 4.3 should, therefore, be further subdivided to permit direct comparisons of the "chosen" mode, the "unsatisfactory" mode and the dimension of evaluation. It was felt that the generally low cell frequencies in the table did not warrant this step but two brief points can be made. The sixteen respondents who mentioned air as more costly than their chosen mode were either train (10) or car (6) travellers. Of the eighteen that believed train involved a longer travel time, twelve were bus passengers. The fact that so few explicit references were made to other modes when respondents explained their mode choices is a little disturbing.[1]

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1. Particularly so when it is recalled that the "mode-choice reason" question and others that lead up to it were explicitly structured in terms of alternative modes considered.

TABLE 4.3 <u>Mode-Choice Reasons: References to Specific Modes</u>[a]

Mode-Choice Reason	Alternative Modes Mentioned in Mode-Choice Reasons										
	Aero-plane	Bus	Taxi	Car	Motor-cycle	Train	Railcar	Road Transport	Ground Transport	Public Transport	TOTAL
Cost	16	2	5	1		3		1			28
Travel Time	1	2				18					21
Safety	2		6					2			10
Access to Mode	2	1	1			3					7
Comfortable Seats		1		2	1				2		6
Preference	1			3		2					6
Relaxing				3		2		1			6
No other possible	2	1	1	1							5
Speed				1					3		4
Waiting										4	4
Convenience	2						1				3
Own Vehicle				2							2
Reliability				1				1			2
Others[b]				2		2					4
TOTAL	26	7	13	16	1	30	1	5	5	4	108

a. Cell entries give the frequency with which that reason for choosing the travel mode was mentioned specifically in comparison with the given alternative mode.

b. "Spaciousness", "Ventilation", "No Worries" and "Crowded" were each mentioned once.

It could be taken to mean that the mode-choice decisions being studied did not consist of conscious evaluations of cognised alternative modes and that for many of the respondents, a choice situation (as formulated in this study) did not, in fact, exist. Use of a given mode of transport might have been completely automatic without involving any sort of conscious decision process. In this type of circumstance one would expect the mode "choice" to be justified in quite general terms that made no reference to the "other modes considered". Another possibility is that the question used to generate these responses did not, in fact, succeed in tapping the factors that entered into particular mode-choice decisions and that the reasons given are merely general qualities associated with the mode concerned. As our present objective is to define a list of relevant mode descriptors these issues are not crucial but they should be borne in mind whenever studies attempt to explain behavioural patterns simply on the basis of the "reasons why".

2) It was mentioned above that a small number of the responses appeared to contain two distinct ideas. Except in one case where the "multiple" reason was coded as a single concept, each constituent idea was coded separately.[1] Such a procedure might not fully

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1. The exception was "a good compromise between cost and comfort". In this case it was clear that the reason was based on the relationship between cost and comfort and not on two separate ideas.

reflect the intentions of the respondents. It is possible that decisions were based on modal qualities taken in conjunction with each other rather than separately as has been implied so far. This suggestion was tested by analysing the first three reasons supplied by each respondent to see if particular combinations of mode-choice reasons did recur consistently.[1]

The anticipated "reasons-combinations" did not appear with any notable frequency in the survey data (Table 4.4). Only 24 per cent of the total number of combinations occurred on six or more different occasions. Two combinations did appear a total of 13 times each but this frequency represents less than 3 per cent of the 496 combinations recorded. If, however, "Travel time" and "Speed" are regarded as identical then Speed-Convenience-Cost emerges as the most frequent combination but it still contributes only 4.8 percent of the total. No attempt was made to search for "sub-combinations" but it is worth drawing attention to the fact that the Convenience-Cost pair occurs 39 times among the combinations presented in Table 4.4 and especially (28 times) for car travellers. This pair of reasons could index a significant dimension along which car travellers justified their choice of mode. Aeroplane passengers, on the other hand, put particular weight on unqualified assertions of either

1. The basic computational procedure used for identifying mode combinations was again followed here. See Appendix 5a for details.

TABLE 4.4 Descriptor Combinations: Mode-Choice Reasons

Reasons Combinations[a,b]	All Surveys No.	All Surveys Percent	Aeroplane	Bus	Survey Travel Mode: Car	Motorcycle	Taxi	Train
			percentage					
Tt, Cv, Cs	13	2.6	0.9	1.1	6.2	33.3	-	-
Tt	13	2.6	10.9	-	0.6	-	-	-
Sp, Cv, Cs	11	2.2	0.9	1.1	4.3	-	15.4	-
Sp	10	2.0	9.1	-	-	-	-	-
Fx, Cv, Cs	9	1.8	-	-	5.6	-	-	-
Sp, Cf, Cv	8	1.6	5.4	-	0.6	-	7.7	-
Sp, Cs, Sf	7	1.4	-	5.3	1.2	-	-	-
Fx	7	1.4	-	-	4.3	-	-	-
Cs	7	1.4	-	-	0.6	-	-	5.2
Sp, Cf	7	1.4	6.4	-	-	-	-	-
Cs, Sf, Ms	7	1.4	-	1.1	0.6	-	-	4.4
Fx, Cs	6	1.2	-	-	3.7	-	-	-
Tt, Cv	6	1.2	4.5	-	0.6	-	-	-
Cv, Cs, Sf	6	1.2	-	3.2	1.2	-	-	0.9
Total number of combinations in this table	117		42	11	48	1	3	12
Total number of combinations[c]	496		110	95	161	3	13	114
Total for this table as a percentage of all combinations[c]		23.6	38.1	11.6	29.8	33.3	23.1	10.5

a. Only those combinations that occurred more than 5 times have been presented.
b. Mode-Choice Reasons: Cf-Comfortable Seats; Cs-Cost; Cv-Convenience; Fx-Flexibility; Ms-Miscellaneous; Sf-Safety; Sp-Speed; Tt-Travel Time.
c. Excluding three "No Response" reasons.

"Speed" or "Travel Time". Twenty percent of the aeroplane survey group responded in this fashion. No similar concentration of mode-choice reasons was found for any of the other main mode surveys.

In Chapter Three an attempt was made to see if the particular "possible", "practicable" and "impracticable" modes reported by respondents could be related to the individual's personal and travel characteristics. A similar type of analysis will now be conducted for the mode-choice reasons. In general it is hypothesised that the personal characteristics of the traveller, his travel experience, and the nature of his trip, are likely to incline him to base his mode-choice decision on certain grounds rather than on others. Thus we might expect, for example, that persons travelling on behalf of a business organization would be less concerned with the costs of travel than people paying for their own journey. As before, the null hypothesis is that the mode-choice reasons reported by respondents are independent of the variables examined.[1] With the data consisting of up to 5 mode-choice reasons per respondent it is again inappropriate to apply the usual tests of significance. Cramer's V^2 is therefore used to index the degree to which the relationship in each contingency table departs from independence. Attention is focussed on the relative power of variables in differentiating the mode-choice reasons rather than the absolute magnitude of any one relationship.

1. Table 3.5 gives the operational definitions for these variables. Practicable Modes Code derived from the mode combinations analysis is added to the list to provide an index of the cognised choice context.

The results of this analysis are set out in Table 4.5.[1] It is Travel Mode that turns out to be the most powerful variable with a V^2 nearly twice the size of the second rank variable, Car Ownership. In view of the substantial differences among the survey travel modes in terms of the reported mode-choice reasons discussed above this result is hardly surprising but the analysis does permit us to pinpoint the most significant elements of those differences. Nearly 20 per cent of the chi-square value was contributed by one cell of the contingency table.[2] Car travellers mentioned "Flexibility" very much more frequently than expected under the null hypothesis. In contrast aeroplane, bus and train travellers put very little emphasis on this aspect but these three cells taken together contributed only 11 per cent of chi-square.[3] Other highlights of this table index the relatively high weight air travellers accorded to "Travel Time", "Comfortable Seats" and "Speed" while train passengers mentioned "Miscellaneous" reasons more frequently than expected and car users showed substantial concern for

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1. In order to meet the requirements for calculating chi-square (and hence V^2), it was necessary to reduce the number of separate "reasons" by regrouping all those mentioned fewer than 35 times into a "Miscellaneous" category. This procedure defined the eleven "reasons" (including "Miscellaneous") that form the basis of all of the tests reported in Table 4.5). For some variables additional regrouping of the reasons categories was required and in the cases of the two travel class variables measured for train travellers it was necessary to take the regrouping of the reasons even further. No value of V^2 was calculated for Travel Experience by Motorcycle or for Travel Class (Air) as the conditions required for the calculation of chi-square could not be fulfilled.
2. Appendix 5b presents the detailed table from which these interpretations were drawn.
3. Regrettably, no measure of the importance of "Flexibility" to taxi and motorcycle users is possible as these two sets of responses were amalgamated so that the conditions of the analysis could be met.

TABLE 4.5 Differentiating the Mode Descriptors: Mode-Choice Reasons

Variable	Cramer's V^2	Rank
A) Personal Characteristics		
1. Sex	.025	8=
2. Age	.015	19=
3. Income	.021	12
4. Occupation	.016	18
5. Ethnic Group	.025	8=
6. Car Ownership	.060	2
7. Motorcycle Ownership	.018	14=
B) Travel Experience		
8. Travel Mode Experience	.019	13
9. Total Travel Experience	.022	10=
10. Travel by Air	.031	4
11. Travel by Bus	.015	19=
12. Travel by Car	.027	7
13. Travel by Motorcycle[a]	-[d]	
14. Travel by Taxi	.010	21
15. Travel by Train	.015	19=
C) Survey Trip Situation		
16. Travel Mode	.114	1
17. Travel Route	.030	5
18. Trip Purpose Code	.028	6
19. Trip Payment	.022	10=
20. Class of Travel		
a) Train i) Class[b]	.035	3
ii) Sleeper[b]	.018	14=
b) Air[c]	-[d]	
21. Size of Travel Group	.018	14=
D) Mode-Choice Context		
22. Practicable Modes Code	.017	17

Median V^2:		
	All Variables	.022
	Personal Characteristics	.023
	Travel Experience Variables	.017
	Survey Trip Situation	.025

a. Only 16 respondents.
b. Only 114 respondents.
c. Only 110 respondents.
d. No valid result was obtained.

"Convenience".[1] Although Table 4.1 showed that most of the mode-choice reasons were applied to all six of the study modes, there is some evidence here that the modes (or air, train, bus and car at least) were viewed in quite different ways and apparently catered for different transportation requirements.

Of the remaining personal, travel experience and trip variables only Car Ownership seems to differentiate the choice reasons to any marked degree. It appears, however, that this variable does little more than restate the differences established by the Travel Mode variable.[2] Respondents not owning nor having the regular use of a car reported choice reasons in the "Flexibility" and "Convenience" categories much less frequently than expected under the null hypothesis and were much more concerned with "Safety". Car owners' responses reversed this distribution but deviated from the expected pattern somewhat less markedly.

No other variable stands out in Table 4.5. Despite the example used above Trip Payment was not an important variable and the relative lack of differentiation on the basis of Income, Occupation, Trip Purpose and Practicable Modes Code should also be noted. It is particularly disappointing that the latter variable revealed so little power as it implies that the cognised choice context had only minor impact on the reasons given to explain the choice made. This result

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1. It was noted above that responses from train passengers covered a wider range of mode-choice reasons than those from the other survey modes. This fact, and regrouping of the less frequent reasons into "Miscellaneous", account for the result.
2. Appendix 5b presents the detailed table from which these interpretations were drawn.

contradicts a basic element of the model formulated here and, unless major sampling or operational errors are invoked, it does not seem likely that it can be "explained away". However, much more work on this point is required before one could state categorically that the structure of the choice context had no major influence on the terms in which the decision was explained.

4.2 Mode Disadvantages

Mode-choice reasons index only the positive or attractive qualities of the mode selected. The analyses reported in Chapter Three suggested that the negative or unattractive qualities of mode alternatives might also be of some considerable importance in the decision process. This section examines the negative mode descriptors reported by inter-city travellers in response to the question:

> "We would like to know how satisfied you are with (X). Please write down the three main disadvantages of travelling by (X) in order of importance: 1, 2, 3."

In all 1290 responses to this question were coded for further analysis and then grouped into the 36 major categories set out in Table 4.6.[1,2] "Safety" was the most frequent mode disadvantage reported and, in so far as it accumulated nearly one and a half times as many responses as the second

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1. See Appendix 6b for an interpretation of each of these categories.
2. The grouping procedure generated twice the proportion of repetitions for disadvantages as for choice reasons: 12.2% compared with 6.1%. Most of the repeated disadvantages came under the "Safety" category (71) with smaller numbers for "Travel Time" (22), "Waiting" (14) and "En-route Facilities" (9).

TABLE 4.6 Mode Disadvantages: Frequency of Mention

Mode Disadvantages[a]	All Surveys No.	All Surveys Percent[b]	Survey Travel Mode: Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			percentage[b]					
Safety	201	16	3	3	36	44	34	-
En-route Facilities	146	11	6	23	3	-	8	18
Travel Time	130	10	1	5	12	-	-	20
Rough Ride	76	6	3	5	9	11	-	5
Waiting	70	5	29	-	-	-	3	1
Heat	65	5	†	13	4	-	5	5
Cost	48	4	7	1	4	-	8	3
Tiring	47	4	1	1	8	-	-	2
Access	45	3	14	†	1	-	8	1
Uncomfortable Seats	38	3	1	8	†	-	-	5
Cleanliness	38	3		2	3	-	3	6
Personal Service	35	3	3	4	-	-	16	4
Crowded	32	2	†	3	-	-	-	8
Road Quality	27	2	-	-	6	11	-	-
Slow	26	2	-	2	†	-	-	6
Reliability	26	2	1	2	3	-	3	1
Cramped	21	2	3	3	†	11	-	1
Seat Reservations	20	2	5	1	-	-	-	2
Timetable	19	1	6	†	-	-	-	1
No Disadvantages	18	1	3	1	1	-	-	1
Noise	17	1	-	1	-	-	3	4
Vehicle Condition	17	1	-	3	-	-	5	2
Taking Luggage	17	1	2	5	-	-	-	1
Poor Information	14	1	-	-	3	-	-	-
Worries	10	1	-	-	2	-	-	†
Cannot see scenery	8	1	2	-	-	-	-	1
Punctuality	7	1	†	2	-	-	-	†
Weather Protection	5	†	-	-	-	11	-	1
Miscellaneous	5	†	2	†	-	-	-	-
Lack of Privacy	3	†		1	-	-	-	†
Fixed Schedule	2	†	†	-	-	-	-	†
Inconvenient	2	†	-	†	†	-	-	†
No Fixed Schedule	1	†	-	-	-	-	3	-
Inflexible	1	†	-	†	-	-	-	-
Loneliness	1	†	-	-	†	-	-	-
No Response	51	4	6	5	4	11	3	1
Total number of disadvantages	1290		231	238	447	9	38	327
Number of respondents		499	110	96	163	3	13	114
Mean number of disadvantages per respondent		2.6	2.1	2.5	2.7	3.0	2.9	2.9

†: Less than 0.5 percent.

a: See Appendix 6b for a fuller interpretation of category titles.

b: Percentages indicate the proportion of responses that come within each category. Because of rounding percentages do not always sum to 100.

disadvantage, it was clearly of considerable importance to these travellers. In fact, the significance of "Safety" might be slightly understated by these figures as the second rank disadvantage is a conglomerate category designated "En-route Facilities" incorporating a multitude of diverse responses ranging from comments on the quality of toilet facilities provided by Malayan Railways to a complaint that overhead powerlines interfere with the reception of car radios and a demand for banking facilities at airports.[1] Third rank is taken by a more traditional mode descriptor, "Travel Time". It is worth noting that the difference in frequency of mention between "Travel Time" and "Speed" is much more pronounced in the case of mode disadvantages than with mode reasons. This suggests that the two concepts were, in fact, distinguished by these travellers and so helps justify the retention of separate categories. After "Travel Time" frequencies drop substantially to a group of three categories: "Rough Ride", "Waiting" and "Heat". The position of "Waiting" is of some interest because if it was joined with "Travel Time" the combination would almost equal "Safety" in frequency of mention. From its premiere position on the reasons list "Cost" has dropped to a comparatively minor position and little separated it from the categories "Tiring" and "Access" which head the long tail of the distribution. "Punctuality" is one of the more notable features of the lower frequency disadvantages: the travellers studied apparently have relatively few complaints about this aspect of transport performance. "Timetable" and "Seat Reservation" problems arouse a little concern but an

1. This category combines 33 separate response codes.

equivalent number of responses indicates that nearly 4 per cent of the respondents reported explicitly that they found no disadvantages in their travel mode. Adding the "No Response" category to this explicit expression of satisfaction suggests that nearly 14 per cent of the survey group could offer no complaint against their travel mode.

Differences among the six modes surveyed are again readily apparent. The concern for safety among car, taxi and motorcycle travellers is particularly pronounced. Bus passengers had relatively little concern for safety and this is somewhat surprising when it is noted that buses had the highest accident rate of all vehicle types classified in Table 4.7. These figures, however, include all road traffic (inter-city, rural and urban) and permit no assessment of the relative casualty rates. It might be expected that minor accidents involving commercial buses are almost certain to be reported to the police whereas minor accidents involving private cars are often taken no further.[1] More realistic estimates of objective safety can be calculated from average annual mileage data given in the report of the national transportation survey (Nathan Associates, 1968). On the basis of the calculated accident rate per thousand vehicle miles buses and taxis are the least dangerous modes. Incorporation of a factor for passengers carried would further increase the relative safety of these two modes but it must be emphasised that these figures do not refer solely to inter-city movements.

1. Malaysian law requires that all accidents "owing to the presence of a motor vehicle on a road" be reported to the police within 24 hours (Road Traffic Ordinance 1958, Pt 11, Section 45, pp.47-48).

TABLE 4.7 Traffic Accidents in West Malaysia, 1969

	Private Cars	Trade Vehicles	Private Motorcycles	Buses	Taxis
Vehicles on the road[a]	213,247	62,221	312,686	5,353	5,955
Vehicles involved in accidents[a]	7,670	2,227	4,562	841	540
Accident rate per vehicle on the road	.036	.036	.015	.157	.091
Average annual mileage[b]	9,000		5,000	65,000	50,000
Accident rate per thousand vehicle miles	.0040		.0030	.0024	.0018

Sources: a - Royal Malaysia Police: Statistical Report on Road Accidents in West Malaysia 1969.

b - Nathan Associates, 1968: Transport Development in Malaysia; Volume 3, Annex B, page 60.

The figures presented are those for petrol engined private cars but for diesel engined buses and taxis.

Turning to other disadvantages it can be seen from Table 4.6 that both train and bus passengers evince a relatively strong concern for the quality of "En-route Facilities" while both train and, to a lesser extent, car travellers considered "Travel Time" to be a major disadvantage of their respective modes. Air travellers contributed virtually all of the responses that came under the "Waiting" and "Access" categories. Wide variation in the foci of user dissatisfactions are especially noticeable when the two most frequently mentioned categories are isolated for each survey mode. Car travellers referred mainly to "Safety" and "Travel Time"; train passengers were concerned with "Travel Time" and "En-route Facilities". Bus passengers were also dissatisfied with "En-route Facilities" but regarded "Heat" as the second main disadvantage. "Waiting" and "Access" were the main problems for air travellers while taxi and motorcycle users focussed on "Safety" and, in the case of taxis, "Personal Service". In contrast to this varied picture the principal mode-choice reasons reveal notable similarities. Both train and bus respondents cite "Cost" and "Safety" in that order. Those travelling by aeroplane and taxi did so primarily for the reasons of "Travel Time" and "Speed". However, it can hardly be inferred from this summary that train and bus, on the one hand, and aeroplane and taxi on the other, presented essentially similar images to inter-city travellers. Certainly the main areas in which performance did not match user expectations differed markedly among these modes.

The overall ranking of mode disadvantages displayed in Table 4.6 invoked the somewhat unrealistic assumption that all disadvantages were of equal import to respondents. As with the mode-choice reasons an attempt is now made to weight each disadvantage in terms of its relative importance to the respondent concerned. Two ranking scales are constructed. The first uses only the most important disadvantage reported by each respondent while the second employs arbitrary weights to derive a single scale of relative importance from the first three disadvantages on each questionnaire (Table 4.8).[1] Rank correlations of these scales with the scale of "overall frequency" again indicates only minor differences.[2] For "most important disadvantage" the main change in rank position was that of "En-route Facilities" which dropped from second position on "overall frequency" to fifth. On the composite weighted scale "En-route Facilities" climbs back to third position thereby showing that although many of the responses in this category were not always accorded prime importance they still often occurred second or third on individual lists. None of the principal mode disadvantages shifted more than two rank positions between the "overall frequency" and "weighted importance" scales. There were some minor changes between the "overall" and "most important" scales (lower positions for "Cleanliness" and "Personal Service" and a higher rank for "Slow") but in summary the importance scales constructed for disadvantages deviated even

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1. The same set of weights as used for mode-choice reasons was again used here: most important disadvantage x3; second disadvantage x2; third disadvantage x1.
2. The coefficients 0.92 and 0.99, for "most important disadvantage" and "weighted importance" respectively, were unchanged when corrected for ties.

TABLE 4.8 Relative Importance of Mode Disadvantages

Mode Disadvantages	Overall Frequency		Most Important Disadvantage		Weighted Importance	
	Number[a]	Rank	Number[a]	Rank	Number[a]	Rank
Safety	202	1	69	1	384	1
En-route Facilities	146	2	31	5	244	3
Travel Time	130	3	61	2	274	2
Rough Ride	76	4	32	4	157	5
Waiting	70	5	35	3	161	4
Heat	65	6	22	7	125	6
Cost	48	7	23	6	101	7
Tiring	47	8	14	9=	89	8=
Access	45	9	14	9=	89	8=
Uncomfortable Seats	38	10=	11	13	70	10
Cleanliness	38	10=	8	16=	65	12=
Personal Service	35	12	6	18=	57	14
Crowded	32	13	12	11=	66	11
Road quality	27	14	12	11=	55	15
Slow	26	15=	18	8	65	12=
Reliability	26	15=	10	14=	54	16
Cramped	21	17	1	28=	30	21
Seat Reservation	20	18	8	16=	42	18
Timetable	19	19	10	14=	44	17
Noise	17	20=	6	18=	32	19
Vehicle Condition	17	20=	6	18=	27	22
Luggage	17	20=	4	22	31	20
Poor Information	14	23	2	25=	17	25
Worries	10	24	3	23=	18	24
Cannot see Scenery	8	25	5	21	20	23
Punctuality	7	26	3	23=	14	26
Weather Protection	5	27=	2	25=	8	28
Miscellaneous	5	27=	2	25=	9	27
Lack of Privacy	3	29	-	31=	4	29
Fixed Schedule	2	30=	-	31=	3	30=
Inconvenient	2	30=	1	28=	3	30=
No Fixed Schedule	1	32=	-	31=	1	34
Inflexible	1	32=	-	31=	2	33
Loneliness	1	32=	1	28=	3	30=

a. Excluding "No Response" and "No Disadvantages" less from the overall frequency scale than those developed for mode-choice reasons. Defining the mode descriptors simply in terms of the most frequently mentioned reasons and disadvantages rather than the weighted importance scales is therefore unlikely to distort measurements of mode images to any significant degree.

The present formulation of the mode-choice process leads to the expectation that choice reasons would tend to refer explicitly to the "unsatisfactory" alternatives that were eliminated in the course of the decision. Although this deduction obtained very little support from the In-transit Survey data one might anticipate that the mode disadvantages should also exhibit specific references to other methods of transport. Intuitively we might argue that a person will feel dissatisfaction with a given situation only if he believes (rightly or wrongly) that the situation could, or should, be more satisfying. Thus we would not expect, under normal conditions, air travellers to express dissatisfaction with the speed of the flight. On the other hand bus passengers are quite likely to express dissatisfaction with their rate of progress because they know (or believe) that there is usually less traffic on the road or that the vehicle is capable of a higher speed or that the road could be straighter and have a better surface. The knowledge or belief on which such dissatisfaction would be based presumably derives from real or imagined experience of that or another mode. Thus we might expect mode disadvantages to be expressed in such terms as "usually very punctual", "not as comfortable as train", or "slower than taxi". In fact even fewer mode disadvantages responses contained explicit references to other modes of transport than did the mode choice reasons.[1] Only eleven responses (0.8 per cent of the 1290 disadvantages) made such explicit references and they were contributed only by car and train travellers (Table 4.9). Four out of the eleven commented that bus travel was cheaper than the travel mode being used. One conclusion that might be drawn from the analysis of specific references to other modes in mode-choice reasons and mode disadvantages is that, at least in the case of these respondents, the mode-choice decision is not as neatly structured in terms of clear-cut alternatives as we might like to believe. Obviously the point requires a great deal more attention than is possible in this study.

The problem of separating responses that were intended to go together did not arise with the mode disadvantages as it did with the mode-choice reasons. However the consistent association, by respondents, of particular disadvantages is of some interest in its own right and so "disadvantages-combinations" were computed following the same procedure that was adopted for the mode-choice reasons. As the "No Disadvantages" and "No Response" categories were excluded, a smaller number of responses entered this analysis (430 compared with 496 for the reasons). Even less evidence of

1. Attempts to tabulate the disadvantages that were based on departures from the "usual situation" had to be abandoned as it was often impossible to be sure whether the respondent was referring to "departures from the usual situation" or to "the usual situation which departed from the ideal". It became clear, however, that many of the respondents to the car travel survey had highly idealistic views as to what usual driving conditions <u>should</u> have been.

TABLE 4.9 Mode Disadvantages: References to Specific Modes[a]

	Alternative Modes Mentioned in Mode Disadvantages			
Mode Disadvantage	Aeroplane	Bus	Taxi	Total
Cost		4	2	6
Travel Time	2			2
Slow		1	1	2
En-route Facilities	1			1
Total	3	5	3	11

a. Cell entries give the frequency with which that disadvantage of the travel mode was mentioned specifically in comparison with the given alternative mode.

consistent association of ideas emerge from the disadvantages combinations (Table 4.10). Only 15.8 percent of the combinations recurred 6 or more times whereas in the case of mode-choice reasons the proportion was 23.6. Two of the disadvantages combinations appear 12 times each but if "Waiting" and "Travel Time" are counted together the new single element combination easily exceeds that frequency. Even so "Waiting-Travel Time" accounts for only four percent of all responses. User dissatisfaction with passenger transport, when expressed by single mode disadvantages, clearly focussed on aspects of "Safety", "En-route Facilities" and "Travel Time" (Table 4.6). Insofar as they were not frequently associated in the main disadvantages-combinations it would appear that these three descriptors were mutually exclusive dimensions of mode satisfaction.

In Section 4.1 it was found that there was some tendency for the mode-choice reasons reported by a particular respondent to be related to certain personal and travel characteristics of the individual. Similarly it might be expected that mode disadvantages would also be related to the selected variables. In particular it might be hypothesised that mode disadvantages mentioned would be related to the amount of travel experience of the respondent. Those with substantial experience of their travel mode, or of other modes in general, are more likely to be aware of the high levels of service that could be attained but perhaps were not reached during the surveyed journey. Such experience would probably also include specific instances of particularly low service levels that would be readily recalled and tend to overshadow general

TABLE 4.10 Descriptor Combinations: Mode Disadvantages

Disadvantages Combinations[a,b]	All Surveys No.	All Surveys Percent	Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			Survey Travel Mode percentage					
Sf, Rr	12	2.8	1.1	-	7.9	-	-	-
Sf	12	2.8	1.1	1.3	6.4	-	8.3	-
Wt	9	2.1	10.0	-	-	-	-	-
Tt	8	1.9	-	1.3	3.6	-	-	1.9
Ef	8	1.9	1.1	6.4	-	-	-	1.9
Wt, Ac	7	1.6	7.7	-	-	-	-	-
Ef, Sf	6	1.4	-	3.8	1.4	-	-	0.9
Sf, Ry	6	1.4	-	1.3	3.6	-	-	-
Total number of combinations in this table	68		19	11	32	-	1	5
Total number of combinations[c]	430		90	78	140	2	12	108
Total for this table as a percentage of all combinations[c]		15.8	21.1	14.1	22.8	-	8.3	4.6

a. Only those combinations that occurred more than 5 times have been presented.
b. Mode Disadvantages: Ac-Access to mode; Ef-En-route Facilities; Rr-Rough Ride; Ry-Reliability; Sf-Safety; Tr-Travel Time; Wt-Waiting.
c. Excluding "No disadvantages" and "No response".

satisfaction on more numerous occasions. One might also expect that individuals belonging to relatively high socio-economic groups (as indexed here by the income and occupation variables) would tend to be somewhat more demanding of service levels than those of lesser standing.

Neither of these hypotheses receives much support from the analyses summarized in Table 4.11. The two main experience variables (Travel Mode Experience and Total Travel Experience) were ranked only 9th and 13th respectively in terms of their power to differentiate the mode disadvantages. Income (12th) and Occupation (17th) were no better. Once again "Travel Mode" emerges as the most powerful variable. The degree to which it surpasses all of the others emphasises the point that the modes cater for quite different aspects of transportation demand and generate quite different expectations which may or may not be satisfied. Dissatisfactions expressed by the respondents focus most sharply on the air passengers' strong concern with "Waiting" and "Access" and the car travellers' worry about "Safety".[1] In each case the frequency of response is very much greater than expected under the null hypothesis and these three cells (of the 85 in the contingency table) contribute 47 per cent of the total chi-square value. Other elements of the contingency table that deviated substantially from the null hypothesis might also be briefly noted. Both train and aeroplane passengers mentioned "Safety" less frequently than expected while the most notable disadvantage reported by bus passengers was "Heat". Bus passengers also complained about the lack of

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1. Appendix 5b presents the detailed tables from which these interpretations were drawn.

TABLE 4.11 Differentiating the Mode Descriptors: Mode Disadvantages

Variable	Cramer's V^2	Rank
A) Personal Characteristics		
1. Sex	.028	14
2. Age	.022	16
3. Income	.032	12
4. Occupation	.021	17
5. Ethnic Group	.052	4=
6. Car Ownership	.061	3
7. Motorcycle Ownership	.036	10
B) Travel Experience		
8. Travel Mode Experience	.039	9
9. Total Travel Experience	.031	13
10. Travel by Air	.071	2
11. Travel by Bus	.016	20
12. Travel by Car	.034	11
13. Travel by Motorcycle[a]	-[d]	
14. Travel by Taxi	.015	21=
15. Travel by Train	.020	18
C) Survey Trip Situation		
16. Travel Mode	.187	1
17. Travel Route	.052	4=
18. Trip Purpose Code	.051	6
19. Trip Payment	.045	8
20. Class of Travel		
(a) Train i. Class[b]	.027	15
ii. Sleeper[b]	.050	7
(b) Air[c]	-[d]	
21. Size of Travel Group	.017	19
D) Mode-Choice Context		
22. Practicable Modes Code	.015	21=

Median V^2:	
All Variables	.033
Personal Characteristics	.032
Travel Experience Variables	.031
Survey Trip Situation	.050

a. Only 16 respondents.
b. Only 114 respondents.
c. Only 110 respondents.
d. No valid result was obtained.

"En-route Facilities" whereas car travellers made exceptionally few comments about them.

Such strong differentiation of the mode disadvantages by travel mode seems to overshadow the effect of other variables. Travel Experience by Air is found to be the second most powerful variable in terms of the computed value of V^2. In fact, 68.6 per cent of the magnitude of this V^2 is based on the same two disadvantages ("Waiting" and "Access") that were of such importance before. Respondents with little experience of air travel rarely mentioned "Waiting" and "Access" while these disadvantages were cited far more frequently than expected by travellers who reported extensive experience of air travel. The power of the Car Ownership variable was also dominated by "Waiting" but in this case some of the other disadvantages, namely "Safety" and "En-route Facilities", were almost as important.

One final point might be made from this analysis. Previous sections of this study have remarked on the apparently poor relationship between personal characteristics of the individual and his own definition of the mode-choice context or the reasons given to explain his actual decision. Some slight evidence was also obtained to support the suggestion that the immediate situation within which a decision was made provided a more promising set of explanatory variables than the usual socio-economic characteristics of the decision-maker. Analysis of the mode disadvantages reported by respondents supports these findings. Table 4.11 shows clearly that the Survey Trip variables reveal stronger relationships with the mode disadvantages than those variables indexing the personal characteristics of the decision maker.

4.3 Summary

The above discussion of mode-choice reasons and mode disadvantages has explored in some depth the various criteria that respondents to the In-transit Survey used to evaluate their travel mode. Information on the features of modes that travellers find attractive and on the aspects that do not meet expectations should be of interest to transport operators and planners wanting to provide the kind of transport facilities desired by travellers. Although the low response rate and the uneven spread of responses across the different modes reduces the substantive value of these results, the In-transit Survey was the first of its kind in Malaya and provided basic data and methodological experience invaluable for future surveys.

A second objective of this part of the study derived from the need to identify a set of relevant mode descriptors that could be used to define the scales for a semantic differential instrument required to measure mode images. Unfortunately the detailed analyses reported above could not be completed before the semantic differential had to be finalised and so the scales were selected after a more limited analysis of the data available at the time. It remains, now, to compare the set of selected descriptors with the overall distribution of reasons and disadvantages obtained from the In-transit Survey. In view of the close correspondence between the overall frequency distributions and those based on weighted importance the following analysis will be based simply on the raw frequency distribution.[1] Many of the mode disadvantages were essentially polar equivalents of the mode-choice reasons and so, by combining frequencies, it is possible to derive the single ranking of mode descriptors presented in Table 4.12. Asterisks indicate the descriptors that were used in the semantic differential. It can be seen that, with few exceptions, the selected descriptors did include all of the most frequently mentioned categories. The most important omission, insofar as it ranked fourth on the combined list, was "En-route Facilities". Discussion of the mode disadvantages pointed out that this category included a very wide range of highly specific comments. It is felt, therefore, that such a scale would be too vague for use in the semantic differential. On the other hand, the selection of "Social Status" might now be considered surprising. The use of this descriptor stemmed from the writer's informal observations which suggested that real or imagined status played a substantial role in everyday life in Malaya.[2] Status, of course, is a highly emotive

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1. It should be noted, of course, that any system of weights used to establish importance rankings would be, on the basis of the information available here, purely arbitrary.
2. Illustrations of this point are not difficult to find.
   (a) A senior Singapore official had been served by the police with a subpoena and given a ticket warrant for an express bus so that he could appear as a prosecution witness in a Melaka court. The official did not turn up in court but wrote to the magistrate explaining that "in view of his position he was not inclined to travel by bus" (Straits Times, April 21, 1970).
   (b) Foo Ho Loke, writing in a student publication deplored the "psychological barrier against using bicycles in this campus" (1970, p.16).
   (c) Car number plates can also be used to demonstrate status. Bids of up to $S11,000 have been made for particular registration numbers (Straits Times, December 19, 1970).

TABLE 4.12 Mode Descriptors: Overall Frequency of Mention

Mode Descriptor	Choice Reasons	Disadvantages	Total	
Safety	112	202	314	*
Cost	249	48	297	*
Travel Time	150	130	280	*
En-route Facilities	30	146	176	
Flexibility	142	1	143	*
Convenience	137	2	139	*
Speed	100	26	126	*
Seating Comfort	86	38	124	*
Relaxation	71	47	118	*
Smooth Riding	2	76	78	*
Waiting	5	70	75	*
Ventilation	7	65	72	*
Accessibility	15	45	60	*
Cleanliness	11	38	49	*
Timetabling	28	19	47	*
Scenery	39	8	47	*
Spaciousness	24	21	45	*
Crowding	9	32	41	*
Personal Service	6	35	41	
Preference	41	-	41	
Reliability	7	26	33	
Own Vehicle	32	-	32	
Road Quality	5	27	32	
Taking Luggage	13	17	30	*
Seat Reservation	9	20	29	
Miscellaneous	19	5	24	
No Disadvantages	-	18	18	
Noise	-	17	17	*
Travel in a group	17	-	17	
Vehicle Condition	-	17	17	
Information	1	14	15	
No other possible	13	-	13	
No worries	3	10	13	
Meet People	10	1	11	
Fixed Schedule	8	2	10	
Decision by Others	10	-	10	
Punctuality	2	7	9	*
Suitable Distance	7	-	7	
Privacy	3	3	6	
Weather Protection	-	5	5	
Social Status	5	-	5	*
No Fixed Schedule	-	1	1	
No Response	3	51	54	
Total	1,431	1,290	2,721	

* denotes the descriptors used in the semantic differential questionnaire.

concept and though it might consciously influence behavioural patterns people are probably unlikely to admit it. This might help explain the small number of "Social Status" responses among the mode descriptors. "Luggage", "Noise" and "Punctuality" were included as scales because it was felt at the time that they tapped significant dimensions along which modes of transport were evaluated. The surprisingly low frequency of mention for "Punctuality" has been explained in terms of its lower significance in the context of inter-city travel compared with intra-city movements. Of the descriptors attaining higher frequencies than "Luggage" and "Noise" several are essentially "non-responses" (e.g. "Preferences", "Miscellaneous", "No Disadvantages") while others would not have been considered because they refer to qualities specific to just one mode or to a restricted group of modes (e.g. "Personal Service", "Own Vehicle", "Road Quality" and "Seat Reservation").[1] The remaining descriptor, "Reliability", was considered but, after much effort to write a clear, precise and concise scale definition, was eventually discarded. Although they do not include all of the most frequently mentioned descriptors, the 21 actually used in the semantic differential are unlikely to have distorted the mode images reported in Chapter Five.

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1. Descriptors of this type were deliberately excluded when the Mode Image questionnaire was constructed. The experience reported in this chapter suggests, however, that such non-general descriptors should have been included after all.

CHAPTER FIVE: MODE IMAGES

It has been argued that individual actors behaving within a given environment organise their cognitions of that environment in terms of a finite number of elements. For this study, these elements have been defined in terms of concepts or ideas used as verbal bases of description when an individual describes a particular section of that environment. Cognitions of a city street, for example, might be expressed in terms of height of buildings, congestion on the footpaths, attractiveness of the shop windows and noise of the traffic. Although some of the descriptors used might well be common to several individuals, it was also argued that the particular set of descriptors used by any person can vary considerably from those used by another person in the same situation. Chapter Four showed that this was indeed so for the descriptors of modes of transport reported by respondents to the In-transit Survey. Nevertheless an attempt has been made to isolate a small number of descriptors that would seem to be widely applicable among inter-city travellers in Malaya.

Knowledge of environment (and, in this case, of modes of transport) is not defined simply by the criteria used to describe or evaluate environment. Objects, even when judged on the same criterion, can still be seen to differ. One street can be more congested than another; one mode of transport might be regarded as less safe than the others. It is the cognised differences between objects, rather than their similarities, that affect the outcome of choices among alternatives. An adequate definition of knowledge held of environments or objects demands, therefore, assessment of the differences between them on each criterion as well as the specification of the relevant criteria themselves.

The semantic differential was selected as the most suitable measuring technique for this study and the 21 mode descriptors identified in Section 4.3 established the semantic dimensions along which knowledge or images held of aeroplane, bus, car, motorcycle, taxi and train were to be measured. Each descriptor was defined by two polar adjectives (or adjectival phrases) and became a separate scale in the semantic differential instrument (Table 5.1). A total of 257 respondents rated the six modes on each of these scales.[1] As the ratings obtained from a semantic differential are interval data, they can validly be used in a variety of mathematical procedures.[2] In Chapter Six these measures are used to model the mode preference decisions reported by the study group. Here, however, the nature of the measured mode images is investigated in some detail. An "average" or "typical" image of each mode is described in terms of the mean response value for each descriptor and the

1. Administrative details of the Mode Image Survey, in which the semantic differential was used, are given in Section 2.3.2 and Appendix 3b. A copy of the Mode Image questionnaire is provided in Appendix 3a. It should be emphasised that, in comparison with the In-transit questionnaire which dealt only with the travel mode, the Mode Image Survey obtained information on each respondent's cognitions of all six modes.
2. See Osgood et. al., 1957, pp.146-153. Heise, 1969, also provides evidence on this point.

TABLE 5.1 Mode Descriptors and Semantic Scale Definition

Mode Descriptor	Semantic Scale Definition	
Safety	Safe	Dangerous
Cost	Cheap	Expensive
Travel Time	Short Travel Time	Long Travel Time
Flexibility	Can Go Anywhere	Restricted to One Route
Convenience	Convenient	Inconvenient
Speed	Fast	Slow
Seating Comfort	Comfortable Seats	Uncomfortable Seats
Relaxation	Relaxing	Tiring
Smooth Riding	Smooth Ride	Rough Ride
Waiting	No Waiting	Much Waiting
Ventilation	Cold	Hot
Accessibility	Easily Accessible	Access is Difficult
Cleanliness	Clean	Dirty
Timetabling	Convenient Departure Times	Inconvenient Departure Times
Scenery	Can See Scenery	Cannot See Scenery
Spaciousness	Plenty of Space	Cramped
Crowding	Not Crowded	Crowded
Taking Luggage	Easy to Take Luggage	Difficult to Take Luggage
Noise	Quiet	Noisy
Punctuality	Always on Time	Never on Time
Social Status	High Social Status	Low Social Status

degree to which responses vary around that mean.[1] The data are further analysed to see if they do index images distinct from one mode to another and to examine the possibility that the images measured might vary consistently with the personal characteristics or travel experience of the respondents. Finally, the accuracy of travellers' knowledge is investigated with the help of data from the In-transit Survey. First, however, a brief analysis is made of the scales viewed by respondents as irrelevant or meaningless for the evaluation of particular modes of transport.

5.1 Irrelevant Descriptors

Although the scales used for the semantic differential were derived from the mode-choice reasons and mode disadvantages reported during the In-transit Survey it was felt that they would not necessarily be meaningful to all respondents or for all modes. Consequently the usual semantic differential format was adapted so that it allowed respondents to identify those scales that appeared to have no relevance for a given mode.[2] In fact, only 1.8 per cent of a possible

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1. To simplify the discussion of the results from these analyses it was necessary to orient all of the scales to a common desideratum. This has been done on the basis of the pole of each scale assumed to be most favourable toward mode-choice (identified by the left hand adjective or adjectival phrase in Table 5.1). In most cases selection of the most favourable pole is not difficult. Most people would want safe, cheap, convenient, relaxing travel. A few scales, however, are more ambiguous. Very fast travel could be thought unsafe. Scenery might be regarded as an unwelcome distraction by travellers wanting to concentrate on reading, writing or conversation. These exceptions are probably rare and so the scales are taken as oriented in Table 5.1.
2. See Section 2.2.3.2.2 for a discussion of this change.

32,382 semantic differential responses used this option and so it can be argued that the scales employed were, on the whole, meaningful descriptors of the modes studied. However some points of interest do emerge from Table 5.2 which summarises the occurrence and context of these responses.

More than half of the "irrelevant scale" responses were associated with the images held of motorcycle and focussed particularly on the aspects of "Crowding", "Spaciousness", "Waiting", "Punctuality", "Accessibility", and "Ventilation". Car images also generated a number of "scale is irrelevant" responses that, with the addition of "Cost", concentrated on essentially the same set of descriptors as motorcycle. Few notable features emerge from the remaining modes and so the analysis points to a distinction between the public modes of transport (aeroplane, bus, taxi and train) and the private modes (motorcycle and car). Given the fundamental differences between public and private transportation this distinction is not entirely unexpected.[1] Descriptors meaningful for evaluations of modes of public transport need not be equally meaningful for images of private vehicles. Table 5.3 indicates the main points of difference that emerged between private transport (car and motorcycle) and public transport (air, bus, taxi and train) for the study group. "Crowding", "Waiting" and "Spaciousness" are most prominent among the variables seen as relatively less

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1. Studies of modal split have often used a private-public distinction as the first stage in their analysis. See, for example, Reeder (1956), Bostick and Todd (1966), Stowers and Kanwit (1966), Tomazinis (1967), Paine et. al. (1969) and Williams (1969).

TABLE 5.2 Mode Descriptors Viewed as Irrelevant

Descriptor	TOTAL %[a]	Aero-plane %[a]	Bus %[a]	Car %[a]	Motor-cycle %[a]	Taxi %[a]	Train %[a]
		Mode Described					
Safety	0.2	0.4	-	0.4	0.4	-	-
Cost	1.2	-	0.8	3.9	1.9	0.8	-
Travel Time	0.6	-	-	1.2	2.3	-	-
Flexibility	0.3	0.4	0.4	0.8	0.4	-	-
Convenience	0.6	0.8	0.4	-	2.3	0.4	-
Speed	0.3	-	0.4	0.8	0.8	-	-
Seating Comfort	0.7	-	-	0.8	3.1	-	0.8
Relaxation	0.8	0.4	-	0.8	2.3	1.2	0.4
Smooth Riding	0.6	1.9	-	-	0.8	-	0.8
Waiting	2.9	0.8	-	4.7	11.6	-	-
Ventilation	2.7	2.7	1.2	2.3	8.9	0.4	0.8
Accessibility	2.3	1.6	0.4	2.7	8.9	-	0.4
Cleanliness	2.3	0.8	-	1.9	10.1	0.8	0.4
Timetabling	2.1	2.3	0.4	3.1	4.7	1.2	0.8
Scenery	0.5	1.2	0.4	-	1.6	-	-
Spaciousness	4.5	1.9	0.8	4.3	18.3	1.6	0.4
Crowding	5.1	-	-	5.4	23.3	0.8	0.8
Taking Luggage	1.0	0.8	-	-	5.0	-	-
Noise	0.7	0.4	-	1.2	2.7	-	-
Punctuality	4.5	0.4	0.8	10.1	11.2	4.3	-
Social Status	2.9	0.4	1.6	3.1	5.4	2.7	3.9
Total "Irrelevant" Responses	570	44	19	122	325	36	24
Total Number of Responses	32382	5397	5397	5397	5397	5397	5397
Percentage "Irrelevant"	1.8	0.8	0.4	2.3	6.0	0.7	0.4

a Percentages give the number of "irrelevant" responses as a proportion of the total number of responses to a particular scale.

TABLE 5.3 Mode Descriptors Viewed as Irrelevant: The Distinction Between Public and Private Transport

Mode Descriptor	Public Modes		Private Modes		All Modes	
	No.	%[a]	No.	%[a]	No.	%[a]
Crowding	4	0.4	73	14.2	77	5.0
Spaciousness	12	1.2	58	11.3	70	4.5
Punctuality	14	1.4	54	10.5	68	4.4
Social Status	23	2.2	23	4.5	46	3.0
Waiting	2	0.2	41	8.0	43	2.8
Ventilation	12	1.2	29	5.6	41	2.7
Access	6	0.6	31	6.0	37	2.4
Cleanliness	5	0.5	31	6.0	36	2.3
Timetabling	12	1.2	20	3.9	32	2.1
Cost	4	0.4	15	2.9	19	1.2
Taking Luggage	2	0.2	13	2.5	15	1.0
Relaxation	5	0.5	8	1.6	13	0.8
Seating Comfort	2	0.2	11	2.1	13	0.8
Noise	1	0.1	10	1.9	11	0.7
Convenience	4	0.4	6	1.2	10	0.6
Smooth Riding	7	0.7	2	0.4	9	0.6
Travel Time	0	-	9	1.8	9	0.6
Scenery	4	0.4	4	0.8	8	0.5
Flexibility	2	0.2	3	0.6	5	0.3
Speed	1	0.1	4	0.8	5	0.3
Safety	1	0.1	2	0.4	3	0.2
TOTAL	123		447		570	
Total Number of Responses	21,588		10,794		32,382	
Percentage "irrelevant"		0.6		4.1		1.8

a Percentages give the "irrelevant" responses as a proportion of the total number of responses to that scale.

meaningful for descriptions of private modes than public modes. On the other hand four descriptors ("Safety", "Flexibility", "Speed" and "Scenery") generate very few "irrelevant scale" responses and might appear to be the most useful descriptors over all six modes. But it should be emphasised that the great majority of the responses to the semantic differential instrument regarded the selected scales as meaningful for the description of mode images.

5.2 Summary Mode Images

Two aspects of the summary image of each mode are reported. The "average" image is defined by the arithmetic means of the meaningful (not "irrelevant") ratings accorded to each of the 21 semantic scales. An index of the degree to which each mean represents a consensus of the respondents is obtained from the standard deviation of scale ratings. These statistics are reported in Tables 5.4 and 5.5 respectively and Table 5.6 ranks the modes in order from most favourable to least favourable according to the mean rating on each scale. A detailed description of the average mode images is obtained by considering each semantic scale in turn.[1]

SAFETY. Train was viewed as the safest mode but only marginally ahead of car while motorcycle and taxi were rated the most dangerous. None of the modes achieved a notable consensus of opinion on safety. Respondents displayed most

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1. Scales are discussed in the order of "importance" established in Table 4.12. The same ordering is followed for all remaining tables in this chapter.

TABLE 5.4 Mean Mode Images[a]

Semantic Scale	Air	Bus	Car	Motor-cycle	Taxi	Train
Safe - Dangerous	3.74	3.23	2.73	5.89	5.09	2.53
Cheap - Expensive	6.84	2.38	4.00	2.14	4.25	3.94
Short Travel Time - Long Travel Time	1.38	4.95	2.85	4.14	2.83	4.51
Can Go Anywhere - Restricted to One Route	5.80	5.53	1.41	1.46	3.04	6.46
Convenient - Inconvenient	2.73	4.07	1.70	3.30	2.87	3.53
Fast - Slow	1.10	4.31	2.33	3.16	2.17	3.68
Comfortable Seats - Uncomfortable Seats	1.38	4.54	2.11	5.09	3.13	3.86
Relaxing - Tiring	1.57	4.97	2.67	6.09	3.77	3.85
Smooth Ride - Rough Ride	1.56	5.16	2.28	5.48	3.57	3.80
No Waiting - Much Waiting	3.98	5.07	1.66	1.94	4.27	5.15
Cold - Hot	2.50	5.52	3.65	5.43	4.53	4.81
Easily Accessible - Access is Difficult	3.87	3.48	2.13	2.63	2.67	3.48
Clean - Dirty	1.20	4.79	1.77	4.42	3.40	4.13
Convenient Departure Times - Inconvenient Departure Times	3.86	4.15	1.79	2.55	3.20	3.91
Can See Scenery - Cannot See Scenery	3.90	2.19	1.63	2.39	2.52	2.83
Plenty of Space - Cramped	2.33	4.77	2.75	4.47	3.55	3.71
Not Crowded - Crowded	2.16	5.99	2.47	2.54	3.65	5.08
Easy to Take Luggage - Difficult to Take Luggage	3.74	4.83	1.79	6.00	2.64	3.04
Quiet - Noisy	2.56	5.46	2.69	5.59	3.92	5.30
Always on Time - Never on Time	2.78	4.24	2.60	3.18	3.89	3.46
High Social Status - Low Social Status	1.48	4.74	2.25	4.66	3.42	3.44

a Tabled numbers are the arithmetic means of the responses to the semantic differential format when the responses are scored as in:

SAFE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | DANGEROUS

Small mean values represent relatively more "favourable" images than large means.

TABLE 5.5 Mean Mode Images: Image Variability[a]

Semantic Scale	Air	Bus	Car	Motor-cycle	Taxi	Train
Safe - Dangerous	1.94	1.48	1.44	1.26	1.53	1.42
Cheap - Expensive	0.58	1.39	1.77	1.40	1.52	1.64
Short Travel Time - Long Travel Time	1.18	1.60	1.38	1.81	1.30	1.85
Can Go Anywhere - Restricted to One Route	1.82	1.74	1.06	1.03	2.02	1.01
Convenient - Inconvenient	2.14	1.80	1.24	2.12	1.36	1.73
Fast - Slow	0.48	1.61	1.11	1.50	0.99	1.78
Comfortable Seats - Uncomfortable Seats	1.01	1.68	1.18	1.68	1.40	1.76
Relaxing - Tiring	1.11	1.52	1.47	1.31	1.55	1.75
Smooth Ride - Rough Ride	1.16	1.43	1.23	1.54	1.59	1.85
No Waiting - Much Waiting	2.12	1.63	1.28	1.42	1.71	1.74
Cold - Hot	1.26	1.29	1.40	1.80	1.33	1.51
Easily Accessible - Access is Difficult	2.32	1.77	1.54	1.87	1.32	1.83
Clean - Dirty	0.78	1.69	1.09	1.88	1.56	1.82
Convenient Departure Times - Inconvenient Departure Times	2.20	1.85	1.58	1.88	1.70	1.90
Can See Scenery - Cannot See Scenery	2.24	1.16	1.01	1.61	1.31	1.50
Plenty of Space - Cramped	1.49	1.81	1.63	1.95	1.69	1.98
Not Crowded - Crowded	1.50	1.33	1.50	1.59	1.82	1.80
Easy to Take Luggage - Difficult to Take Luggage	2.21	1.64	1.10	1.58	1.39	1.82
Quiet - Noisy	2.14	1.35	1.49	1.50	1.52	1.58
Always on Time - Never on Time	1.85	1.90	1.90	1.86	1.83	1.96
High Social Status - Low Social Status	1.13	1.63	1.32	1.59	1.39	1.53
Mean variability[b]	1.56	1.59	1.37	1.63	1.52	1.70

(Column heading "MODE" spans Air through Train.)

a Variability in mode images is indexed by the standard deviation of the responses to the semantic differential format when the responses are scored as in:

SAFE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | DANGEROUS

Small standard deviations represent a greater consensus among respondents than large values.

b Mean image variability for each mode is defined as the arithmetic mean of the standard deviations computed for each of the semantic scales.

TABLE 5.6 Mean Mode Images: Rank Order on Semantic Scales[a]

Semantic Scale	Air	Bus	Car	Motor-cycle	Taxi	Train
			MODE			
Safe - Dangerous	4	3	2	6	5	1
Cheap - Expensive	6	2	4	1	5	3
Short Travel Time - Long Travel Time	1	6	3	4	2	5
Can Go Anywhere - Restricted to One Route	5	4	1	2	3	6
Convenient - Inconvenient	2	6	1	4	3	5
Fast - Slow	1	6	3	4	2	5
Comfortable Seats - Uncomfortable Seats	1	5	2	6	3	4
Relaxing - Tiring	1	5	2	6	3	4
Smooth Ride - Rough Ride	1	5	2	6	3	4
No Waiting - Much Waiting	3	5	1	2	4	6
Cold - Hot	1	6	2	5	3	4
Easily Accessible - Access is Difficult	6	4=	1	2	3	4=
Clean - Dirty	1	6	2	5	3	4
Convenient Departure Times - Inconvenient Departure Times	4	6	1	2	3	5
Can See Scenery - Cannot See Scenery	6	2	1	3	4	5
Plenty of Space - Cramped	1	6	2	5	3	4
Not Crowded - Crowded	1	6	2	3	4	5
Easy to Take Luggage - Difficult to Take Luggage	4	5	1	6	2	3
Quiet - Noisy	1	5	2	6	3	4
Always on Time - Never on Time	2	6	1	3	5	4
High Social Status - Low Social Status	1	6	2	5	3	4

a Modes are ranked in order away from the "favourable" pole of the semantic scale according to the mean response value for each mode. This table is based directly on Table 5.5.

agreement about the danger involved in motorcycle travel but were quite ambivalent in the case of journeys by aeroplane.

COST. Two modes, motorcycle and bus, were viewed as relatively inexpensive methods of travel. Train and car received very similar ratings at a higher cost level. Aeroplane stands out with a mean cost rating over two scale points more expensive than any other mode and a very marked degree of consensus among respondents. Perceptions of cost varied most in the case of car.

TRAVEL TIME. Aeroplane travel rated the shortest travel times while bus was accorded the longest. The mean travel time ratings showed virtually no difference between taxi and car on this scale although there was slightly more agreement on the value for taxi.

FLEXIBILITY. Predictably it is the two private modes, car and motorcycle, that were regarded, on the average, as the most flexible methods of travel and respondents were in relatively close agreement over this image. Yet they were even more agreed on their view of train as a relatively inflexible mode of transport, considerably less flexible than air. As scheduled air services operated into only nine airports in Malaya during 1970 this is a rather surprising result. It would appear however that the respondents interpreted the idea of route flexibility in the strict sense and were well aware of Malaya's restricted "Y" shape railway network (Figure 2.2).

CONVENIENCE. It is not easy to interpret the word "convenient" when it is applied to transportation. Normally one would expect it to incorporate ideas of easy access and flexibility of route. Car obviously fits this interpretation but the high rank revealed by air (more convenient than taxi) is difficult to understand, though the large standard deviation does indicate substantial differences of opinion among the respondents. The low ratings given to bus and train are also somewhat strange as their terminals are normally of easier access to urban transport routes than an airport some miles out of town. Clearly, the concept of convenience is a complex one.

SPEED. The mean images of mode speed followed exactly the same rank order as for travel time but tended to represent much closer agreement among the respondents. It is on this scale that aeroplane achieved the least variability of all the ratings with only 13 of the 257 responses falling outside the "very fast" category. Taxi was seen as slightly faster than car while bus emerged as the slowest mode some way behind train.

SEATING COMFORT. Aeroplane and motorcycle, respectively, rated the most and the least seating comfort. Respondents viewed car as the second most comfortable way of travel and placed it more than a full scale point ahead of taxi.

RELAXATION. For relaxation the rank order is identical with that for comfort but in terms of the absolute numerical value of the means all modes except train were seen as somewhat less favourable on this scale. The modes are well separated with at least a full scale point between them although train and taxi reveal similar average ratings.

SMOOTH RIDING. The rank order of the modes on smooth riding is also identical with that for seating comfort and relaxation. Air was seen to offer the smoothest journeys and motorcycle the roughest.

WAITING. Private modes of transport take first and second ranks on this scale but, in terms of the mean ratings, motorcycle was seen to involve somewhat more waiting than car. Train journeys were believed to involve the most waiting with bus only slightly better. The relatively favourable rank attained by aeroplane seems to contradict the evidence of the mode disadvantages reported for the In-transit Survey but the large standard deviation shows that there was no firm consensus on this aspect of air images.

VENTILATION. Although one respondent to the In-transit Survey did comment that aircraft cabins were too cold, it can be assumed that, in a tropical climate, cool or air-conditioned travel vehicles are viewed more favourably than those without this facility. In the present study aeroplane was rated the coolest mode and bus the hottest. Respondents apparently did not believe that the windblown motorcyclist obtains much relief from tropical temperatures as the mean rating for that mode was only marginally more favourable than the one obtained for bus.

ACCESSIBILITY. The relatively high rating achieved by aeroplane for convenience is made even more difficult to interpret when it is realised that aeroplane was seen as the least accessible mode, though it should be noted that respondents' ratings varied considerably around the calculated mean value. As expected the two private modes obtain the most favourable mean ratings on accessibility but the apparent gap between car and motorcycle and the small difference between motorcycle and taxi are somewhat surprising.

CLEANLINESS. In the days of steam locomotion railway travel was sometimes a smoky, dirty experience. Diesel engines have seen the end of such problems but trains often retained a reputation for lack of cleanliness. The data presented are therefore most interesting as, in terms of the mean mode images both bus and motorcycle were seen to be dirtier than train. Aeroplane and car rated as the cleanest modes some way ahead of taxi. Respondents showed a considerable degree of consensus in their image of a relatively clean aeroplane.

TIMETABLING. As might be expected the private modes were believed to have the most convenient departure times but again car was seen in much more favourable light than motorcycle. Taxi emerged as the most convenient of the commercial modes with aeroplane marginally better than train. Bus received the least favourable mean rating.

SCENERY. Although the mean value ranks aeroplane last on this scale the large standard deviation shows that the respondents were far from agreed on this point. Bus was rated second only to car for sight-seeing and, over all scales, this was seen as the most favourable aspect of bus travel. It is somewhat surprising that train was rated less favourably for seeing the scenery than all the modes except air.

SPACIOUSNESS. There is some uncertainty as to how respondents interpreted the "plenty of space - cramped" scale. From the mean ratings it would appear that few images of mode spaciousness included the idea of "room to walk around and stretch my legs". Train, with the space afforded by corridors and aisles, ranks only fourth on this scale. Aeroplane was seen as offering most space followed by car and taxi while bus was viewed as most cramped.

CROWDING. The rank order on crowding closely follows that found for spaciousness except that motorcycle was rated much more favourably on the crowding scale. Conversely, the mean ratings show that bus and train were considered substantially more crowded than might have been predicted from the spaciousness values.

TAKING LUGGAGE. Respondents clearly believed that car provided the easiest way of carrying luggage with taxi some way back in second rank. Despite the separate stowage of luggage on aircraft and the luggage check system, aeroplane was seen to create more difficulties in this aspect than train. Again, however, there was considerable variability in the ratings of air. Motorcycle was viewed as the mode least suitable for the carrying of luggage.

NOISE. On the basis of the mean ratings aeroplane was judged the quietest mode of the six but aeroplane responses again varied substantially around the mean. Three modes (train, bus and motorcycle) were seen to involve quite unfavourable levels of noise. It would appear as though respondents have interpreted the scale in terms of noise experienced by the traveller rather than by the non-travelling observer. Even so the magnitude of the difference between the ratings for car and taxi is somewhat surprising.

PUNCTUALITY. Although they all operate on the basis of a published timetable bus, train and aeroplane were accorded quite different standards of punctuality. Aeroplane, only slightly less punctual than car, was rated the best of the three while bus was judged the worst. Long distance taxis do not usually operate to any fixed schedule of times (some four per cent of the taxi responses on this scale indicated that the scale was "irrelevant") and yet, despite the favourable ratings on speed and travel time, taxis fared poorly on punctuality. It is notable that motorcycle was regarded as markedly less punctual than car although a motorcycle would appear less subject to the traffic conditions that commonly delay a car.

SOCIAL STATUS. As might be predicted, aeroplane was rated the most socially desirable method of travel although the degree of consensus was perhaps lower than expected. Car took second rank with a substantial gap to taxi and train which were barely separated for third and fourth place. Lowest rank on the social status scale went to bus but it was not far behind motorcycle.

Few travellers, if any, would give equal weight to all of these factors in their mode-choice decision but it is of interest to summarise the mean images and the rankings accorded to each mode (Table 5.7).

AEROPLANE. Taken over all 21 scales aeroplane emerges as a mode of extremes. It was ranked first on eleven of the scales but sixth and last on another three. It obtained the most favourable individual mean rating ("Speed") and also the least favourable ("Cost"). The distribution of responses on the various scales for aeroplane also included the strongest agreement ("Speed") and the greatest divergence of

TABLE 5.7 Mean Mode Images: Rank Order Summary[a]

Rank	Aeroplane	Bus	Car	Motorcycle	Taxi	Train
			Mode			
1	11	-	8	1	-	1
2	2	2	10	4	3	-
3	1	1	2	3	12	2
4	3	2	1	3	3	10
5	1	6	-	4	3	6
6	3	10	-	6	-	2
Sum of Ranks	53	105	38	86	69	89
Mean Rank	2.5	5.0	1.8	4.1	3.3	4.2

a Table entries give the frequency with which each mode attained the given rank on the mean mode images. This Table is derived directly from Table 5.6.

opinion ("Accessibility"). It is this range in aeroplane images that pulls it back from an expected first rank overall to second place behind car.

BUS. The respondents to the Mode Image survey saw few favourable characteristics in bus and the mode obtains the lowest overall rank. In some aspects the poor rating revealed by bus is difficult to understand (e.g. those for "Crowding", "Ventilation", "Waiting" and "Punctuality") and one wonders if the image of inter-city bus travel suffers by association with intra-urban bus services. Only on the scales of "Scenery", "Safety", "Cost" and "Accessibility" did bus receive mean ratings that were at all favourable but in all cases except "Scenery" there was relatively little agreement among respondents on the mean rating value.

CAR. Car received relatively favourable ratings on all the scales (its lowest ranking was the fourth for "Cost"). As judged by the arithmetic means of the variability indices (standard deviations) calculated for each scale the respondents tended to exhibit a greater overall agreement in their image of car than for the other modes. Agreement was particularly strong for the "Scenery", "Flexibility", "Cleanliness", "Taking Luggage" and "Speed" scales. Of the six modes car received the highest mean rank.

MOTORCYCLE. Ranks for motorcycle were spread over the whole range and the mode finished fourth overall. "Flexibility", "Waiting" and "Cost" were motorcycle's most favourable mean ratings and the respondents were in particularly strong agreement about "Flexibility". It is notable that the greatest variability in opinion occurred over judgements of the "Convenience" of motorcycle. There is, perhaps, some suspicion of a prejudice against motorcycle. On certain scales where one might expect to find little difference between motorcycle and car (e.g. "Accessibility", "Convenience", "Waiting", "Timetabling" and "Punctuality") the gap between the mean ratings is quite marked and always to the disadvantage of motorcycle.

TAXI. With no very high or very low ranks, taxi emerged in third place overall. In certain aspects such as "Cost", "Noise" and "Punctuality" long distance taxi travel also appears to have suffered from association with intra-urban services. Taxi rated particularly favourably on the "Speed" scale and it was on this point that the respondents were most agreed in their images of taxi. Least agreement occurred over the "Flexibility" of long distance taxi services.

TRAIN. In all respects except "Safety", "Scenery" and, perhaps, "Taking Luggage" train was perceived relatively unfavourably. Even with the favourable mean rating for "Scenery" the mode obtained only fifth rank on that scale. In the case of "Cost", train gained third rank although the mean rating was relatively poor. Respondents were in close agreement on the mean rating for "Flexibility" but in general the responses for train varied considerably around the calculated average value. This is particularly true for "Spaciousness", "Punctuality" and "Timetabling". Of the six modes studied the respondents showed least agreement in their images of train. Overall, train obtained fifth position on the mean ranks.

This discussion of the summary mode images has revealed few major departures from one's intuitive expectations of the relative positioning of modes on any particular scale. Logically the next stage in the analysis of these mode images would be an assessment of their accuracy in relation to the real world. However, this topic is deferred until Section 5.5 and attention is now directed at a related, but more immediately disturbing issue, namely the considerable variation of responses around the mean calculated for each scale.

5.3 Variation in the Measured Mode Images

Examination of the mean ratings for each scale suggested that the semantic differential instrument had generated seemingly realistic measurements of mode images. It could well be, however, that the variability in these data shades the image of one mode into that of another and destroys any semblance of a distinct image for each mode. Figure 5.1 illustrates this point. In A the distributions of responses for each mode exhibit relatively little dispersion around their respective mean values and there is only minor overlapping between adjacent modes. Although the mean values do not change, the situation in B is quite different from that represented by A. Responses for each mode now vary markedly around their means and there is considerable overlap between the distributions. In this case the data can hardly be taken to represent distinct images of what are, in fact, quite different modes of transport. When images have been measured on several scales the problem of distinguishing between these two possible situations is much more complex

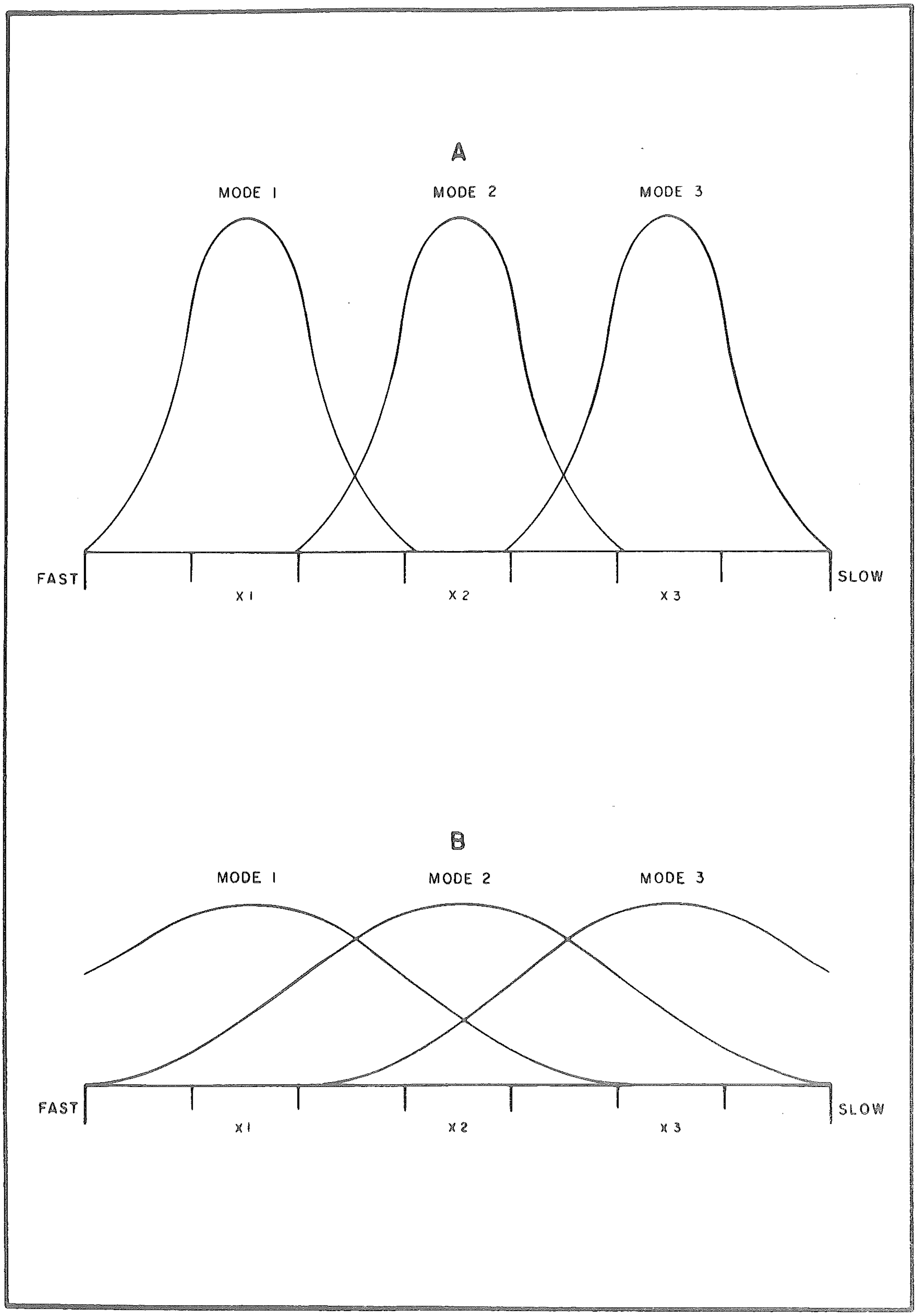

Figure 5.1 Variation in Measured Mode Images

than the simplified, univariate example in the Diagram. However it can be handled by the multivariate extension of the analysis of variance model (MANOVA). The MANOVA model examines the "realness" of the differences among the centroids (means) of two or more populations when each population is represented by a series of observations comprising measurements on each of several variables. For the present analysis we have six populations (or modes of transport) and each of them is defined by measurements on the 21 scales that made up the semantic differential instrument. A total of 257 sets of such measurements on each mode has already been summarised scale by scale (Section 5.2). The data were also input to a MANOVA model to see if the measured mode images could be regarded as distinct entities or if the variability in the data was such that there were no real differences between them.[1]

The initial test of six modes taken together showed that there was indeed a very substantial amount of difference among the centroids (Table 5.8). Even if the test had involved only one and four degrees of freedom (rather than the 105 and 7417 actually available) the computed F value would still have been significant at the 0.001 level of probability. In

1. In undertaking this analysis a problem arose from the "irrelevant scale" responses discussed in Section 5.1 as they became, in effect, missing data. According to the original formulation by Osgood et al. these responses would have been scored at the midpoint of the affected scale. However it was felt that this procedure could bias the results (e.g. the mean value of the "Crowding" scale for motorcycle would be altered from 2.54 to 3.27) and so each "irrelevant scale" response was replaced by the mean value calculated for that scale by disregarding all such responses (Table 5.4 sets out these mean values).

statistical terms this is a highly significant result but it should be made clear at this stage that the MANOVA model is used purely as a descriptive device. The respondents who provided the data were in no way a sample drawn from a specific universe but simply comprised various groups of individuals who were prepared to complete the Mode Image questionnaire. Given this situation it would be inappropriate to focus on the inference statistics derived from the MANOVA analysis. As the aim here is to identify the main sources of variation in the mode image data, applications of the MANOVA model are interpreted in terms of the generalised correlation ratio eta-square and the role of an individual scale (or variable) within the overall model is indexed by the univariate eta-square.[1,2]

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1. According to Gribbons and Lohnes, "η (eta) is as close to a correlation coefficient as one can come for relations involving a nominal variable, and that η^2 expresses the proportion of criterion variance explainable by the predictor variance. The MANOVA η is similar to a multiple correlation" (1969, p559).
2. We might also note that analysis of variance techniques depend on the assumption of homogeneity in the population or group dispersions. In the present case the assumption cannot be upheld because (with 1155 and 3452680 degrees of freedom) an F value greater than 1.0 signifies that the differences among the population dispersions are significant at the 0.01 level. Cooley and Lohnes comment that "Many research workers prefer to ignore the issue of the homogeneity of group dispersions on the grounds that the test of H (equality of group centroids) is probably fairly robust under departures from its assumptions. Also, these multivariate tests are quite powerful, so research on large samples is quite likely to lead to a rejection of H (homogeneity of group dispersions) with some consequent embarrassment to a MANOVA theory for the data" (1971, p234). As the present research is based on large samples and as the interpretation of the MANOVA model focusses on a correlation ratio rather than the inference statistics, the homogeneity of group dispersions is assumed for all further analysis.

TABLE 5.8 MANOVA Analysis of the Six Mode Images

Number of Groups: 6 (Aeroplane, Bus, Car, Motorcycle, Taxi, Train)

Number of Observations: 257 in each group.

Number of Scales: 21

(means and standard deviations for each scale are given in Table 5.4 and Table 5.5 respectively)

FOR EQUALITY OF DISPERSIONS: MANOVA F = 3.452

Degrees of Freedom: 1155 and 3452680

FOR EQUALITY OF CENTROIDS: MANOVA F = 87.49

Degrees of Freedom: 105 and 7417

ETA-SQUARE = 0.981

UNIVARIATE ANALYSES: Degrees of Freedom: 5 and 1536

Scale	F - ratio	Eta-square
Flexibility	573.1	0.651
Cost	351.4	0.534
Relaxation	308.0	0.501
Waiting	273.7	0.471
Crowding	255.5	0.454
Cleanliness	254.9	0.445
Seating Comfort	240.3	0.439
Taking Luggage	222.3	0.420
Waiting	217.6	0.415
Social Status	210.2	0.406
Safety	200.2	0.395
Speed	197.0	0.391
Noise	191.6	0.384
Travel Time	188.5	0.380
Ventilation	166.8	0.352
Spaciousness	75.2	0.197
Scenery	63.9	0.172
Timetabling	63.3	0.171
Convenience	54.7	0.151
Accessibility	36.3	0.106
Punctuality	30.2	0.090

Taking this step simplifies the interpretation of the analysis and it can be immediately seen that distinguishing the six modes accounts for some 98 percent of the variance in the mode image responses.[1] It is therefore clear that the separate mode images do not disappear into a single amorphous "fog" because of data variability. Yet this result could have equally well been obtained from a situation where five modes were indistinguishable and only one was at all separate. To check for this possibility (or some variant of it) each mode was tested separately in a MANOVA model against every other mode. The results of these tests are summarised in Table 5.9 which identifies those scales contributing most to the differences between the modes being considered, and in Table 5.10 where the main similarities between the modes are set out.

From Table 5.9 it is clear that the semantic differential responses do index quite distinct mode images. Only in the comparison of bus and train does the distinction between the two sets of data fail to account for more than 65 percent of the variance in the responses. Aeroplane and motorcycle reveal the most marked differences overall, particularly on the "Cost", "Speed", "Waiting" and "Cleanliness" scales.

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1. Table 5.8 also details the role of individual scales within the MANOVA model as defined by separate applications of the simple analysis of variance model. "Flexibility" emerges as the main index of the differences among the modes and the six images contribute 65 percent of the variance in the responses to that scale. "Cost" and "Relaxation" are the next most important scales. Six scales ("Spaciousness", "Scenery", "Timetabling", "Convenience", "Accessibility" and "Punctuality") contribute relatively little to the differentiation of the mode images.

TABLE 5.9 MANOVA Comparisons of Paired Mode Images: Discrimination[a]

MODES	OVER-ALL ETA-SQUARE	SCALE																				
		Safety	Cost	Travel Time	Flexibility	Convenience	Speed	Seating Comfort	Relaxation	Smooth riding	Waiting	Ventilation	Accessibility	Cleanliness	Timetabling	Scenery	Spaciousness	Crowding	Taking Luggage	Noise	Punctuality	Social Status
Aeroplane/Bus	.900		81				65				65			65								
Aeroplane/Car	.841		54		68		34				31											
Aeroplane/Motorcycle	.913		82		68				78		67											
Aeroplane/Taxi	.818		56						40			38		45								
Aeroplane/Train	.780		58	50			50							53								
Bus/Car	.847				67						58							61	54			
Bus/Motorcycle	.847	48			67						52							61				
Bus/Taxi	.763			35			39											35	34			
Bus/Train	.497		21							14									21			15
Car/Motorcycle	.825	58							60	57									72			
Car/Taxi	.652	39			20						43			27								
Car/Train	.878				85						57							39		42		
Motorcycle/Taxi	.768		34						40		36								57			
Motorcycle/Train	.907	61			85						51								44			
Taxi/Train	.737	43		21	53		22															
Frequency		5	7	3	8	0	5	0	4	2	9	1	0	4	0	0	0	4	6	1	0	1

a. Cell entries are the eta-square values computed from the univariate analysis of variance performed for each scale. As the decimal points have been omitted the numbers indicate the percentage of the variance in the scale responses that is accounted for by the distinction between the two modes. Only the four scales that revealed the greatest differences have been identified in each case.

TABLE 5.10 MANOVA Comparisons of Paired Mode Images: Similarities[a]

MODES	OVER-ALL ETA-SQUARE	SCALE: Safety	Cost	Travel time	Flexibility	Convenience	Speed	Seating Comfort	Relaxation	Smooth riding	Waiting	Ventilation	Accessibility	Cleanliness	Timetabling	Scenery	Spaciousness	Crowding	Taking Luggage	Noise	Punctuality	Social Status
Aeroplane/Bus	.900	02			01								01		01							
Aeroplane/Car	.841																02	01		00	00	
Aeroplane/Motorcycle	.913					02							08					01			01	
Aeroplane/Taxi	.818					00					01				03				08			
Aeroplane/Train	.780												01		00			03	03			
Bus/Car	.847	03											15			05					16	
Bus/Motorcycle	.847									00						01				00		00
Bus/Taxi	.763										05		07			02					01	
Bus/Train	.497										00		00		00					00		
Car/Motorcycle	.825				00						01		02					00				
Car/Taxi	.652		01	00			01						04									
Car/Train	.878	01	00														07				05	
Motorcycle/Taxi	.768					01							00		03	00						
Motorcycle/Train	.907					00								01						01	01	
Taxi/Train	.737								00	01							00					00
Frequency		3	2	1	2	4	1	0	1	2	4	0	9	1	5	4	3	4	2	4	6	2

a. Cell entries are the eta-square values computed from the univariate analysis of variance performed for each scale. As the decimal points have been omitted the numbers indicate the percentage of the variance in the scale responses that is accounted for by the distinction between the two modes. Only the four scales that revealed the least differences have been identified in each case.

But, even so, they were seen as very similar when judged by "Crowding", "Punctuality" and "Convenience". Motorcycle and train also generated very distinct images with the differences being most noticeable in "Flexibility", "Cost, "Waiting" and "Taking Luggage". In terms of "Convenience", "Noise" and "Punctuality", however, they were barely separated. On the basis of physical appearance and anticipated travel performance it might be expected that car and taxi would generate very similar images. The measured mode images do show them to be close in matters of "Travel Time", "Cost", "Speed" and "Accessibility" but over all scales these two images show considerably more separation than the case of bus and train. "Waiting", "Safety", "Cleanliness" and "Flexibility" emerge as the main points of difference between car and taxi.[1]

There is little fear, then, that the dispersion of the mode image responses around the means calculated for each scale has blurred and confused the definition of distinct images. Analysis has shown that the measurements index quite separate mode images with bus and train being the most similar but still accounting for almost 50 per cent of the variance in the responses involved. Nevertheless it is apparent from Table 5.5 that considerable variation is present within the reported mode images. Each mode image will therefore be examined in an attempt to determine whether

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1. It might also be noted that the major differences between the modes, as analysed here, can be summarised by considerably fewer than the full 21 scales. Seven scales do not contribute at all to Table 5.9 while "Waiting", "Flexibility", "Cost" and "Taking Luggage" are of importance in at least six of the 15 pairwise comparisons. This point will arise again in Chapter Six.

the variation within the images reveals any systematic relationships with the characteristics of the persons studied.

5.4 Sources of Variation Within Mode Images

Additional details collected at the time the Mode Image questionnaire was completed make it possible to examine a number of variables for their relative contribution to the variance in the semantic differential responses for each mode. These variables cover three main categories, namely the specified type of trip, the personal characteristics of the respondent and measures of his travel experience. The actual recording of an individual's mode images on the semantic differential format was constrained only in very general terms and specification of a particular trip purpose and trip destination was not made until the respondent had completed the mode image section of the questionnaire.[1] In theory, therefore, the distinction between business or holiday trips or between possible journey destinations should not have any marked effect on the measured mode images.[2] On the other hand, however, one might expect to find systematic variations in the images reported by different types of people. Young people might well view motorcycle in a different way from

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1. The wording of the introduction to the mode image section of the questionnaire was "In this study you will be judging the following methods of transport according to your ideas about them for long distance travel (i.e. Kuala Lumpur to Penang; or Kuala Lumpur to Singapore); Aeroplane, Bus, Motorcycle, Private Car, Railcar, Taxi and Train." (Railcar has been excluded from the analyses reported here).
2. Any correlation that might be revealed by the analysis would clearly be spurious and so it could be taken to represent the magnitude of relationship that might arise purely by chance.

those who were older. Car owners could have a different image of car than that reported by non-owners. Similarly we might expect to find experienced travellers having different ideas about particular modes when compared with people having little or no travel experience.

As the MANOVA model required more observations in each input group than there were variables (i.e. the 21 scales), it was necessary to group the response categories in most cases. The definition of each grouping and the number of observations included within that group are given with the results which are displayed for each mode in turn (Tables 5.11, 5.12, 5.13, 5.14, 5.15, 5.16). Interpretation of these analyses is again based on the overall and univariate eta-square values.

AEROPLANE. Subdivision of the respondents into "place of employment" groups accounted for almost 50 per cent of the variance in the mode image measurements of aeroplane (Table 5.11).[1] Of the 21 scales that entered the analysis, "Punctuality", "Flexibility" and "Crowding" were most important in the univariate analyses. In each case the transition from School to University to Government generated progressively less favourable mean ratings. Closer examination to the group images showed that a total of seven scales revealed this pattern. In another nine cases the sequence was spoiled but the School group still exhibited the most

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1. The "place of employment" variable was adopted because the occupation coded for a student was that of his father or guardian and appeared likely to confuse interpretation.

TABLE 5.11 Sources of Variation within Mode Images: Aeroplane

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Main Scales (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (124), Holiday (130)	.085	Punctuality (.02), Noise (.02)
Trip Destination	3	Kuala Lumpur (32), Penang (106) Singapore (117)	.146	Speed (.02), Scenery (.02)
Trip Destination[c]	2	Penang (106), Singapore (117)	.065	Scenery (.02)
Personal Characteristics				
Age	3	Under 20 (72), Twenties (117), 30 and Over (64)	.463	Punctuality (.10), Taking Luggage (.10)
Sex	2	Female (39), Male (212)	.115	Punctuality (.02), Social Status (.02)
Occupation[d]	3	Professional (64), Clerical (87) Production (29)	.212	Spaciousness (.04), Waiting (.03)
Occupation[e]	3	School (67), University (67), Government (81)	.492	Punctuality (.12), Flexibility (.10)
Ethnic Group	3	Malay (86), Chinese (110), Other (54)	.204	Punctuality (.04), Taking Luggage (.03)
Ethnic Group[f]	2	Malay (86), Chinese (110)	.153	Taking Luggage (.03), Convenience (.02)
Income	3	\$0-\$300 (76), \$301-\$750 (69), Over \$750 (69)	.318	Spaciousness (.06), Social Status (.04)
Car Ownership	2	Car (108), No Car (149)	.128	Safety (.02), Crowding (.02)
Motorcycle Ownership	2	Motorcycle (70), No Motorcycle (187)	.103	Waiting (.02), Travel Time (.02)
Travel Experience				
Aeroplane	2	Never (198), Some Experience (59)	.143	Spaciousness (.05), Safety (.02)
Total Travel Experience	2	Never (36), 1-10 Trips (41), Over 10 (180)	.186	Taking Luggage (.03), Flexibility (.03)

(contd)

TABLE 5.11/contd.

a. N - Number of groups input to each analysis.
b. Because some respondents did not provide certain details the total number of observations entering a particular analysis might not total 257.
c. Analysis was repeated to exclude respondents resident outside Selangor.
d. A full description of the groups is: Professional, Technical, Administrative and Managerial; Clerical, Sales and Service; Production Workers and Labourers. (See Table 3.5 for further details).
e. As the occupation coded for a student was that of his father the reported results could be misleading. The analysis was therefore repeated with each respondent grouped according to his "place of employment".
f. Analysis was repeated to exclude the heterogeneous "Other" group.

favourable images. Similar results were obtained from the analysis of age groupings.[1] "Punctuality" retained its position as the most important scale (as indexed by eta-square) and on 15 of the 21 scales the School group generated the most favourable mean scale rating. It would appear as though the younger respondents (and particularly the school students) possessed relatively idealistic images of aeroplane. A cross-sectional study such as this cannot provide strong evidence of temporal change but there is some suggestion here that as people grow older and become financially independent their images of aeroplane become generally less favourable (and more realistic?). Surprisingly, however, the travel experience variables accounted for relatively little of the variance in aeroplane ratings.

BUS. Four of the variables accounted for similar, but comparatively small, proportions of the variance in bus images (Table 5.12). With 26.5 per cent, Income was most important followed by Occupation (26.4), "place of employment" (24.6) and Age (23.0). "Punctuality" was the major scale for both of the first two variables and revealed progressively more favourable mean ratings for increasing income levels and with the transition from "production workers" to "clerical staff" to "professional and managerial occupations". Another 15 scales for the Income analysis and 15 for the Occupation analysis also showed that the respondents reporting a high income level or a high status occupation had the most favourable mean images of bus. Why this should be so is not

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1. In terms of the respondents that fell into particular groups, the age and "place of employment" analyses were similar but by no means identical.

TABLE 5.12 Sources of Variation within Mode Images: Bus*

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Main Scales (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (124), Holiday (13)	.061	-
Trip Destination	3	Kuala Lumpur (32), Penang (106) Singapore (117)	.130	Convenience (.02), Punctuality (.02)
Trip Destination[c]		Penang (106), Singapore (117)	.070	Punctuality (.02)
Personal Characteristics				
Age	3	Under 20 (72), Twenties (117), 30 and Over (64)	.230	Social Status (.05), Scenery (.05)
Sex	2	Female (39), Male (212)	.119	Timetabling (.04), Punctuality (.02)
Occupation[d]	3	Professional (64), Clerical (87), Production (29)	.264	Punctuality (.08), Speed (.06)
Occupation[e]	3	School (67), University (67), Government (81)	.246	Scenery (.06), Social Status (.04)
Ethnic Group	3	Malay (86), Chinese (110), Other (54)	.201	Social Status (.05), Relaxing (.03)
Ethnic Group[f]	2	Malay (86), Chinese (110)	.122	Social Status (.02), Timetabling (.02)
Income	3	$0-$300 (76), $301-$750 (69), Over $750 (69)	.265	Punctuality (.06), Scenery (.05)
Car Ownership	2	Car (108), No Car (149)	.123	Timetabling (.04), Scenery (.03)
Motorcycle Ownership	2	Motorcycle (70), No Motorcycle(187)	.062	Accessibility (.02)
Travel Experience				
Bus	3	Never (66), 1-5 trips (77), Over 5 (114)	.143	Travel Time (.03), Accessibility (.02)
Total Travel Experience	3	Never (36), 1-10 trips (41), Over 10 (180)	.133	Safety (.03), Waiting (.02)

* See Table 5.11 for the footnotes to this Table.

apparent. It may have been that their lack of familiarity with bus had led to relatively idealistic images of that mode. Yet 42 per cent of the group defined here as "high - status" occupations reported substantial experience of bus travel (more than 5 trips) and the corresponding figure for the high income group was 59.2 per cent. Interpretation of these results is clearly complicated by the fact that the student respondents were classified by the occupation and income of their father or guardian. Grouping respondents according to their experience of bus made relatively little contribution to the variance in mode images but it is notable that on 11 of the scales the mean rating for the "no-experience" group was clearly more favourable than the means for the two "experienced" groups.

CAR. The "place of employment" variable contributed more to the variance in car images than any of the others that were examined (Table 5.13). In the case of the aeroplane image the School group revealed markedly more favourable mean ratings but here the situation is reversed. On all except two of the scales ("Cost" and "Ventilation") the School mean ratings represented less favourable images than those found for the University or Government groups. As one might have expected boys to have a fairly idealistic view of car this result is rather surprising. It may be that these school students tended to evaluate car in terms of its performance in a congested urban setting rather than for inter-city journeys on the open road.[1]

1. The school from which these boys were drawn was located beside a busy urban highway. Traffic frequently banked up on the road outside the school because of severe congestion at nearby roundabouts.

TABLE 5.13 Sources of Variation within Mode Images: Car*

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Main Scales (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (124), Holiday (13)	.062	Safety (.02)
Trip Destination	3	Kuala Lumpur (32), Penang (106), Singapore (117)	.246	Social Status (.04), Cleanliness (.03)
Trip Destination[c]	2	Penang (106), Singapore (117)	.175	Social Status (.04), Cleanliness (.03)
Personal Characteristics				
Age	3	Under 20 (72), Twenties (117), 30 and Over (64)	.328	Travel Time (.09), Punctuality (.09)
Sex	2	Female (39), Male (212)	.063	Social Status (.03), Relaxing (.01
Occupation[d]	3	Professional (64), Clerical (87), Production (29)	.372	Travel Time (.10), Social Status (.04)
Occupation[e]	3	School (67), University (67), Government (81)	.440	Timetabling (.12), Travel Time (.11)
Ethnic Group	3	Malay (86), Chinese (110), Other (54)	.221	Punctuality (.04), Travel Time (.03)
Ethnic Group[f]	2	Malay (86), Chinese (110)	.104	Travel Time (.02), Ventilation (.02)
Income	3	$0-$300 (76), $301-$750 (69), Over $750 (69)	.362	Punctuality (.08), Timetabling (.07)
Car Ownership	2	Car (108), No Car (149)	.134	Convenience (.04), Travel Time (.04)
Motorcycle Ownership	2	Motorcycle (70), No Motorcycle (187)	.097	Travel Time (.02), Relaxing (.01)
Travel Experience				
Car	3	Never (54), 1-5 trips (59), Over 5 (144)	.235	Travel Time (.04), Flexibility (.04)
Total Travel Experience	3	Never (36), 1-10 Trips (41), Over 10 (180)	.187	Cost (.02), Noise (.02)

* See Table 5.11 for the footnotes to this Table.

MOTORCYCLE. The School - University - Government groupings also emerged as the major source of variation in the motorcycle images (Table 5.14). According to the eta-square values, "Accessibility" and "Punctuality" were the most discriminating of the scales and in both cases the mean rating value for the School respondents was the least favourable of the three groups. This tendency for School students to have a relatively unfavourable mode image was not as strong here as it was for car. For only 10 of the 21 scales did the School mean appear less favourable than the University or Government values. Motorcycles and scooters form a vital element of the transport on the University of Malaya campus and so one might perhaps have expected the University image of motorcycle to stand out from the other two. In fact this happens on only three scales. On "Scenery" and "Cost" the University mean rating is markedly more favourable whereas for "Crowding" it is less favourable.[1]

TAXI. With some 40 per cent of the variance, "place of employment" was also the major source of variation in the reported taxi images, well ahead of Age, Occupation and Income (Table 5.15). Again we find that the School group indicated a less favourable image than that obtained for the University and Government groups. On four of those scales ("Scenery", "Speed", "Safety" and "Travel Time") the "place of employment" groupings contributed more than 5 per cent of the variance in scale responses. A similar pattern was found for the Age variable with the Under Twenty group

1. This latter result could well be related to the common practice of doubling up on scooters for trips around the university campus.

TABLE 5.14 Sources of Variation Within Mode Images: Motorcycle*

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Scales (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (124), Holiday (130)	.056	Noise (.01)
Trip Destination	3	Kuala Lumpur (32), Penang (106) Singapore (117)	.159	Smooth Riding (.02), Spaciousness (.02)
Trip Destination[c]	2	Penang (106), Singapore (117)	.108	Smooth Riding (.02), Crowding (.02)
Personal Characteristics				
Age	3	Under 20 (72), Twenties (117), 30 and Over (64)	.368	Punctuality (.09), Accessibility (.09)
Sex	2	Female (39), Male (212)	.132	Ventilation (.03), Flexibility (.02)
Occupation[d]	3	Professional (64), Clerical (87), Production (29)	.296	Scenery (.08), Punctuality (.04)
Occupation[e]	3	School (67), University (67), Government (81)	.483	Accessibility (.15), Punctuality (.14)
Ethnic Group	3	Malay (86), Chinese (110), Other (54)	.278	Convenience (.05), Seating Comfort (.04)
Ethnic Group[f]	2	Malay (86), Chinese (110)	.215	Convenience (.05), Seating Comfort (.04)
Income	3	$0-$300 (76), $301-$750 (69), Over $750 (69)	.343	Timetabling (.07), Taking Luggage (.07)
Car Ownership	2	Car (108), No Car (149)	.156	Taking Luggage (.03), Smooth Riding (.03)
Motorcycle Ownership	2	Motorcycle (70), No Motorcycle (187)	.214	Punctuality (.04), Cost (.04)
Travel Experience				
Motorcycle	3	Never (141), 1-5 trips (62), Over 5 (54)	.189	Smooth Riding (.05), Noise (.03)
Total Travel Experience	3	Never (36), 1-10 trips (41), Over 10 (180)	.244	Seating Comfort (.03), Cleanliness (.03)

* See Table 5.11 for the footnotes to this Table.

TABLE 5.15 Sources of Variation Within Mode Images: Taxi*

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Scales (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (124), Holiday (130)	0.053	-
Trip Destination	3	Kuala Lumpur (32), Penang (106), Singapore (117)	.207	Social Status (.04), Taking Luggage (.02)
Trip Destination[c]	2	Penang (106), Singapore (117)	.100	Waiting (.02), Safety (.02)
Personal Characteristics				
Age	3	Under 20 (72), Twenties (117), 30 and Over (64)	.320	Travel Time (.06), Scenery (.06)
Sex	2	Female (39), Male (212)	.082	Taking Luggage (.01), Noise (.01)
Occupation[d]	3	Professional (64), Clerical (87), Production (29)	.274	Scenery (.08), Convenience (.04)
Occupation[e]	3	School (67), University (67), Government (81)	.403	Scenery (.09), Travel Time (.08)
Ethnic Group	3	Malay (86), Chinese (110), Other (54)	.215	Punctuality (.04), Travel Time (.03)
Ethnic Group[f]	2	Malay (86), Chinese (110)	.144	Travel Time (.04), Relaxing (.04)
Income	3	$0-$300 (76), $301-$750 (69), Over $750 (69)	.248	Scenery (.05), Speed (.04)
Car Ownership	2	Car (108), No Car (149)	.111	Travel Time (.03), Cost (.02)
Motorcycle Ownership	2	Motorcycle (70), No Motorcycle (187)	.151	Speed (.03), Seating Comfort (.02)
Travel Experience				
Taxi	3	Never (48), 1-5 trips (93), Over 5 (116)	.095	Punctuality (.01), Timetabling (.01)
Total Travel Experience	3	Never (36), 1-10 trips (41), Over 10 (180)	.148	Flexibility (.03), Punctuality (.03)

* See Table 5.11 for the footnotes to this Table.

clearly more pessimistic about taxi than the older respondents on 11 of the scales. Again we can only suggest that it was their familiarity with congested urban traffic that has influenced the School respondents in this manner.[1]

TRAIN. For train also, "place of employment" emerged as the major source of variation and in this case contributed 47.4 per cent of the variance in the mode image responses (Table 5.16). The pattern established for aeroplane, motorcycle and taxi is reinforced further here with the Age groupings again contributing a substantial portion of the image variance. But whereas the detailed results indicated a tendency for School students to be somewhat idealistic about aeroplane and relatively pessimistic about car, motorcycle and taxi, the measured images of train show quite different trends. Attention focusses on the University respondents and on the Twenties age group for their strong tendency to view train less favourably than the other two groups. Eighteen of the scales for the "place of employment" analysis and sixteen for the Age variable demonstrated this pattern. They included virtually all of the scales for which the groupings accounted for more than 5 per cent of scale variance. "Cost" was the sole exception to this rule and it repeated the earlier pattern where the image became progressively more favourable with increasing age. There is no immediate explanation for the pessimistic view of train reported by the University - Twenties groups.[2] A tabulation

1. Of the 72 respondents classified in the Under Twenty group, 66 were school students.
2. The two groups were not identical. Only 54.7 per cent of the 117 respondents classified Under Twenties were from the University "sample".

TABLE 5.16 Sources of Variation within Mode Images: Train*

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Scales (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (124), Holiday (130)	.045	-
Trip Destination	3	Kuala Lumpur (32), Penang (106), Singapore (117)	.177	Social Status (.03), Smooth Riding (.03)
Trip Destination[c]	2	Penang (106), Singapore (117)	.097	Social Status (.03), Smooth Riding (.02)
Personal Characteristics				
Age	3	Under 20 (72), Twenties (117), 30 and Over (64)	.411	Punctuality (.11), Waiting (.10)
Sex	2	Female (39), Male (212)	.134	Safety (.03), Ventilation (.02)
Occupation[d]	3	Professional (64), Clerical (87), Production (29)	.318	Smooth Riding (.05), Ventilation (.04)
Occupation[e]	3	School (67), University (67), Government (81)	.474	Crowding (.15), Punctuality (.15)
Ethnic Group	3	Malay (86), Chinese (110), Other (54)	.187	Punctuality (.04), Waiting (.03)
Ethnic Group[f]	2	Malay (86), Chinese (110)	.108	Waiting (.03), Cleanliness (.01)
Income	3	$0-$301 (76), $301-$750 (69), Over $750 (69)	.299	Cost (.09), Ventilation (.03)
Car Ownership	2	Car (108), No Car (149)	.141	Cost (.05), Scenery (.02)
Motorcycle Ownership	2	Motorcycle (70), No Motorcycle (187)	.145	Waiting (.08), Timetabling (.04)
Travel Experience				
Train	3	Never (73), 1-15 trips (100), Over 5 (84)	.213	Cost (.07), Timetabling (.04)
Total Travel Experience	3	Never (36), 1-10 trips (41), Over 10 (180)	.240	Convenience (.03), Cost (.03)

* See Table 5.11 for the footnotes to this Table.

of respondents' travel experience against their age showed that although less than half of the School - Under Twenties respondents had ever travelled by train, the other two groupings were not greatly dissimilar. Some 13.6 per cent of the Twenties had no train experience while the comparable figure for the Thirty and Over group was 20.7 per cent. Clearly, the "deviant" images of train held by the University group cannot be explained in terms of different degrees of experience with that mode.

In summarising these analyses of the six modes, then, it can be said that the main source of variation in the mode images was the distinction between School pupils, University students and Government employees.[1] Grouping on the basis of Age was almost as important as the "place of employment" variable and the two sets of analyses revealed very similar "trends" in the mean ratings accorded to the 21 scales. The distribution of respondents on these variables was similar, but not identical, and so one might perhaps summarise the basic source of variation in mode images in terms of personal behavioural maturity. The School pupils, in particular, would probably have relatively little experience at making <u>their own decisions</u> about long distance travel (although some of them have had substantial travel experience). Thus their perceptions of modes might be expected to be less refined than those of the other respondents. It has been shown that the School group revealed comparatively optimistic views of

1. This statement holds, of course, only for those variables that were tested. It may well be that groupings on some other variable would generate more marked variations in mode images. But given the complementary role of the "place of employment" and age variables demonstrated here it is not clear as to what that variable could be.

aeroplane and relatively pessimistic ideas about car, motorcycle and taxi. In the case of train this relationship was less pronounced and seemed to be replaced by the relatively pessimistic attitude to the mode reported by the University respondents.

Only in the analysis of bus was "place of employment" not the main source of variation in mode image. Its place was taken by Income followed by Occupation. But it should be noted that the amount of systematic variation in the bus image was much lower than it was for the other modes and the effect of the "place of employment" and age variables was only marginally less than the first two.

At the other end of the scale it is clear that certain variables have very little apparent effect on mode images. Apart from the Trip Nature variables, Sex seems to have the least effect on the views held of modes of transport and, contrary to what might be expected from common stereotypes in Malaya, Chinese respondents did not reveal mode images markedly different from those of the Malays studied. More surprising, however, were the results obtained from the mode ownership and travel experience variables. Ownership of a car or of a motorcycle had only a minor impact on the images held of those modes and in several cases seemed to have more effect on the knowledge of another mode. Experience of using a particular mode also appeared to generate comparatively little variation in the image of that mode, and in four of the six cases, the crude measure of Total Travel Experience had more effect.

Although the "place of employment" variable accounted for substantial proportions of the variance in five of the six mode images several other relationships with seemingly greater intuitive basis did not emerge to the expected extent. It must be concluded therefore that the measured mode images show little systematic variation from person to person and are, to a large degree, quite personal constructs. The variability of these images is amply demonstrated. It remains now to examine the accuracy of mode images to see how closely knowledge matches the facts of reality.

5.5 Accuracy of Mode Images

Explanations of behaviour in terms of the "economic man" concept assume that decision makers have perfect knowledge of the available alternatives. This section reports a rather limited attempt to test just how accurate knowledge of transport modes is in reality. It must be admitted, however, that the nature of the "knowledge" data used and problems met in trying to define the "real world" (against which the "knowledge" can be tested) render any really substantive conclusions impossible.

Semantic differential measurements permit detailed analyses of individual and group images but they are less suitable for assessing the accuracy of transport knowledge. By its very nature, and even more so with the format changes used here, the semantic differential provides relative rather than absolute measures of mode characteristics. Furthermore the response format compresses the continuum of values on a scale such as "Speed" or "Cost" into a mere seven categories thus losing a good deal of the precision necessary for testing accuracy. There is also the problem of identifying some person with such expert knowledge of the modes that his responses could be used as the "correct" or "objective" values against which the "subjective" images of other respondents could be tested. This latter problem might be overcome by using the mean values calculated for each scale as the objective standard but there is, of course, no guarantee that such means are a true reflection of reality. For this section, therefore, a different approach is taken and attention is directed back to data collected as part of the In-transit Survey.

Most of the mode descriptors used in this study possess no recognised, unambiguous physical scales on which objective measurements of that particular attribute might be made (e.g. "Flexibility", "Convenience", "Relaxation"). However, both "Cost" and "Travel Time" are measured by simple, universally understood physical scales and so provide virtually the only opportunity to assess the accuracy of individual mode images.[1] Although it is hardly a distinguishing characteristic of methods of transport, "Travel Distance" also fulfils these conditions and, in conjunction with "Cost" and "Travel Time", would permit estimates of average speed and cost per mile to be calculated. Accordingly each respondent to the In-transit

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1. Another descriptor that might be used in this way is "Accessibility" which could be measured in terms of the time, distance and cost separation between the journey origin (or destination) and the mode terminus. Obtaining these measurements for a number of respondents could well be extremely laborious. Accident rates could also be used to test "Safety". The discussion of these data in Section 4.2 raised some of the problems involved in their use for this purpose.

Survey was asked to estimate the time his journey would take, its cost and the distance it would cover.[1] As Table 5.17 shows, most of the returned questionnaires provided the estimates requested but it is notable that "Cost" and "Distance" seemed to cause respondents more difficulty than "Time" and, furthermore, that this was particularly the case for air travellers. It must be emphasised that the estimates cannot really represent unbiased indices of the respondent's knowledge about a given mode of transport. The In-transit questionnaire was distributed to people about to start, or actually engaged in, a journey which became, by definition, the survey journey. Respondents therefore had every opportunity to "research" their answers to this question by asking transport personnel, by looking at their ticket or by examining a timetable. Results drawn from this analysis can be taken only as an approximate upper limit on the accuracy of general knowledge concerning methods of passenger transport. Administration of the same questions to the same travellers on some random occasion (not necessarily tied to a particular journey) would probably produce somewhat less accurate responses.

These reports of travel time, cost and journey distance were compared with the corresponding information published by the transport operators. As the "objective" values vary from route to route analysis was, in the first instance, restricted

1. Several other studies have investigated the accuracy of subjective estimates. See, for example, Ekman and Bratfisch (1965), Dornic (1967), Lansing and Hendricks (1967), Reichman (1969), Lee (1970), Neuberger (1971) and Lundberg (1973). Stea (1969) has tested various factors believed to affect estimates of "conceptual metrics" like distance or extensity.

TABLE 5.17 Estimates of Time, Cost and Distance: Response Rates

Survey Mode	Total Number of Respondents	Time		Cost		Distance	
		No.[a]	%[b]	No.[a]	%[b]	No.[a]	%[b]
Aeroplane	110	106	96.4	76	69.1	80	72.7
Bus	96	93	96.9	93	96.9	84	87.5
Car	163	159	97.5	153	93.9	160	98.2
Motorcycle	3	3	100.0	3	100.0	3	100.0
Taxi	13	13	100.0	13	100.0	13	100.0
Train	114	110	96.5	101	88.6	98	86.0
TOTAL	499	484	97.0	439	88.0	438	87.8

a. Gives the number of estimates received for each item.
b. Percentages indicate the proportion of the total number of respondents for the given mode that supplied a particular item.

to cases where ten or more respondents provided information for a particular journey. Even within a given route there could well be several "objective" values. Different classes of accommodation for rail and air travel incur different travel costs but no corresponding change in travel time or distance.[1] For this reason separate analyses have been carried out for each mode-route-class combination wherever sufficient observations were available. Tables 5.18, 5.19 and 5.20 display the results of these tests and present for each case the "real" value, the number of estimates, the smallest and the largest estimate, the mean estimate and the mean accuracy value. Accuracy was defined, for each respondent, by taking the difference between the estimate and the "real" value as a percentage of the "real" value. No distinction was made between underestimates and overestimates in this calculation. The results are discussed briefly.

TRAVEL COST. Bus passengers travelling on the Kuala Lumpur to Kota Baharu route made, on the average, easily the most accurate estimates of travel costs though it is known that they were given some assistance by company personnel when the questionnaires were distributed (Table 5.18). Taxi passengers also make very accurate reports. Taxis do not operate under a fixed schedule of fares (or departure times)

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1. There were also a number of cases where published journey times for a particular mode and route varied from one scheduled service to another. For example, the two night express trains were scheduled to take 10 hours 30 minutes and 11 hours 5 minutes for the Singapore to Kuala Lumpur journey whereas the day express was timetabled at 7 hours 25 minutes. In cases like this the "real" time for a particular respondent was defined as the schedule time that most closely matched his estimate. Because there was no single "real" value the "published time" presented in Table 5.19 is therefore a mean time calculated from the "real" values defined for respondents.

TABLE 5.18 Estimates of Travel Cost[a]

Travel Mode	Journey[b]	Class[c]	Published Cost[d]	Number of Estimates	Range	Mean Estimate	Mean Accuracy[e]
Aeroplane	Kuala Lumpur to Georgetown	Economy	55.00	19	10.00-75.00	52.53	8.3
Aeroplane	Kuala Lumpur to Singapore	Economy	55.00	28	29.50-57.00	50.18	9.2
Bus	Kuala Lumpur to Kota Baharu	-	16.00	60	15.00-16.50	15.97	0.3
Bus	Kuala Lumpur to Ipoh	-	6.50	16	5.00-9.50	6.33	8.5
Car	Kuala Lumpur to Ipoh	-	-	74	2.00-40.00	13.2	40.3
Car	Kuala Lumpur to Georgetown	-	-	45	5.00-70.00	21.9	32.1
Car	Georgetown to Alor Setar	-	-	12	4.00-12.00	8.7	26.8
Taxi	Kuala Lumpur to Ipoh	-	7.00	11	7.00-8.00	7.1	1.3
Train	Kuala Lumpur to Butterworth	Third	13.55	18	11.00-16.00	11.1	15.6
Train	Kuala Lumpur to Singapore	Second(S)	20.4	11	17.40-24.00	20.1	5.0

a. All costs expressed in Malaysian dollars.
b. Includes reverse journeys.
c. S denotes sleeper accommodation.
d. Sources: Aeroplane: Malaysia-Singapore Airlines. Timetable (Effective 1 August 1970).
Bus: Route specifications held by the Road Transport Department.
Taxi: Interviews with taxi drivers.
Train: Malayan Railway Timetable (March 1970).
e. "Accuracy" was defined for each respondent by $\frac{|R - E|}{R} \times 100.0$ where R = "real" cost, E = estimated cost.
For this section of the analysis, "real" cost for car was defined as the mean estimated cost for each route.

and so it could well be that passengers make sure they know the current rate to avoid being overcharged.[1] Although using a single mean estimate as a surrogate for the "real" cost of travel by car would tend to accentuate the magnitude of "errors", it is still apparent that motorists varied greatly in their estimates of cost.[2] Inaccurate knowledge can either emphasise the disadvantages of modes eventually rejected or accentuate the desirable qualities of the mode selected. It is worth noting that in all of the cases presented except taxi the mean estimate of travel cost was less than the "real" value.

TRAVEL TIME. Estimates of travel time appear to be markedly less accurate than those of travel cost (Table 5.19). However it is certain that time estimates would be greatly influenced by the actual performance of the travel mode during the survey trip (and especially so if the journey took longer than it should have). Some evidence for this latter effect is contained in Table 5.19. The mean estimates for one of the aeroplane routes, the taxi journey and the train examples were all greater than the corresponding "real" values. There is also the possibility that some respondents might have included access time in their estimate. Two very large values reported for the Butterworth-Singapore train

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1. The Road Transport Department defines only a maximum mileage rate for "hire cars" or long distance taxis (Motor Vehicles (Commercial Transport) Rules, 1959).
2. Data on the cost of operating a private car under Malayan conditions are presented in Nathan Associates (1968) and could perhaps have been used to obtain a "real" cost for motorists. However, the costs per mile varied considerably according to the size of the car and as information on engine capacity was not collected during the In-transit Survey the possibility was not carried through.

TABLE 5.19 Estimates of Travel Time[a]

Travel Mode	Journey[b]	Class	Published Time[c]	Number of Estimates	Range	Mean Estimate	Mean Accuracy[d]
Aeroplane	Kuala Lumpur-Singapore	-	0.93	47	0.50-2.50	0.90	10.0
Aeroplane	Kuala Lumpur-Georgetown	-	0.66	25	0.50-1.50	0.76	33.4
Aeroplane	Kuala Lumpur-Kota Baharu	-	1.28	10	0.75-1.75	1.28	9.6
Bus	Kuala Lumpur-Kota Baharu	-	13.50	60	6.66-12.50	10.81	20.0
Bus	Kuala Lumpur-Ipoh	-	4.33	16	3.50-5.16	4.07	9.3
Car	Kuala Lumpur-Ipoh	-	-	78	1.66-10.00	3.29	16.8
Car	Kuala Lumpur-Georgetown	-	-	47	4.50-12.00	6.21	13.7
Car	Georgetown-Alor Setar	-	-	11	1.41-2.50	1.72	17.1
Taxi	Kuala Lumpur-Ipoh	-	2.50	11	2.50-3.58	3.07	22.6
Train	Kuala Lumpur-Butterworth	-	8.77	44	7.00-17.16	9.32	7.1
Train	Kuala Lumpur-Singapore	-	7.76	36	5.50-11.75	9.02	17.4
Train	Butterworth-Singapore	-	20.88	13	15.16-48.50	23.83	22.7

a. All times expressed in hours.
b. Includes reverse journeys.
c. Sources: Aeroplane: Malaysia-Singapore Airlines Timetable (Effective 1 August 1970).
Bus: Route specifications held by the Road Transport Department.
Taxi: Interviews with taxi drivers.
Train: Malayan Railway Timetable (March 1970).
d. "Accuracy" was defined for each respondent by $\left|\frac{R - E}{R}\right| \times 100.0$ where R = "real" value, E = estimated value.
For this section of the analysis, "real" cost for car was defined as the mean estimated cost for each route.

route suggest that even over-night stops might have been counted.[1] Using scheduled departure and arrival times to compute "real" travel times could generate misleading notions of accuracy (or inaccuracy) when compared with estimates that relate to actual journeys. Nevertheless, it is transport knowledge (represented here by estimates of travel time) that affects future mode-choice decisions, regardless of how accurate or inaccurate that knowledge might be.

DISTANCE. Although motorists would have the advantage of speedometer readings to assist them in gauging distance, the estimates reported by motorists in this survey were not markedly better than those provided by other respondents (Table 5.20). In fact the mean accuracy of motorists' estimates varied considerably among the routes. Apart from the air travellers, who appeared to think in terms of road distance rather than flying distance, the accuracy achieved on this measure was relatively good. It is noticeable that, in all except two of the cases presented in Table 5.20, mean estimates of journey distance were greater than the "real" value. The two exceptions referred to the same route but there appears to be no immediate explanation for this coincidence or for the broader tendency to over-estimation.

Tables 5.21 and 5.22 summarise the computed "estimates" of cost-per-mile and speed. It might be expected that the combination of two estimates to provide a third would decrease the accuracy of the constructed index and this did happen

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1. The In-transit questionnaire attempted to avoid this possibility by constraining responses to "<u>... YOUR JOURNEY BY THIS TRAIN</u>".

TABLE 5.20 Estimates of Journey Distance[a]

Travel Mode	Journey[b]	Class	Published Distance[c]	Number of Estimates	Range	Mean Estimate	Mean Accuracy[d]
Aeroplane	Kuala Lumpur-Singapore	-	206	44	110-500	254.8	29.7
Aeroplane	Kuala Lumpur-Georgetown	-	172	21	100-500	251.5	50.2
Bus	Kuala Lumpur-Kota Baharu	-	409	55	300-550	421.8	6.9
Bus	Kuala Lumpur-Ipoh	-	135	14	103-165	131.8	8.7
Car	Kuala Lumpur-Ipoh	-	135	77	120-234	136.0	5.4
Car	Kuala Lumpur-Georgetown	-	237	47	134-750	252.2	12.6
Car	Georgetown-Alor Setar	-	60	13	57-150	68.4	15.8
Taxi	Kuala Lumpur-Ipoh	-	135	11	100-140	131.3	5.6
Train	Kuala Lumpur-Butterworth	-	243	41	120-600	264.3	16.9
Train	Kuala Lumpur-Singapore	-	246	30	70-600	265.4	16.1
Train	Butterworth-Singapore	-	489	11	300-1000	527.1	16.7

a. All distances expressed in miles.
b. Includes reverse journeys.
c. Sources: Bus, Car, Taxi: Automobile Association of Malaya, Members' Handbook 1969.
Train: Interstation distances provided by Malayan Railway Administration.
Aeroplane: Straight line distances between airports were measured directly from a map of Malaya.
d. "Accuracy" was defined for each respondent by $\frac{|R - E|}{R} \times 100.0$

where R = "real" value
E = estimated value

TABLE 5.21 Estimates of Travel Cost per Journey Mile[a]

Travel Mode	Journey[b]	Class[c]	Published Cost[d]	Number of Estimates	Range	Mean Estimate[e]	Mean Accuracy[f]
Aeroplane	Kuala Lumpur to Singapore	Economy	27	25	14.7-38.2	23.3	23.0
Aeroplane	Kuala Lumpur to Georgetown	Economy	32	17	5.0-100.0	26.3	44.8
Bus	Kuala Lumpur to Kota Baharu	-	4	55	2.9-5.3	5.0	6.9
Bus	Kuala Lumpur to Ipoh	-	5	14	3.3-9.2	3.8	14.6
Car	Kuala Lumpur to Ipoh	-	-	74	1.5-30.8	9.8	40.9
Car	Kuala Lumpur to Georgetown	-	-	45	2.1-19.3	8.7	26.3
Car	Georgetown to Alor Setar	-	-	12	6.7-20.7	14.2	23.7
Taxi	Kuala Lumpur to Ipoh	-	5	11	5.0-7.0	5.4	6.9
Train	Kuala Lumpur to Butterworth	Second(S)	6	16	2.3-9.5	5.2	19.9

a. All costs expressed in cents per journey mile.
b. Includes reverse journeys.
c. S denotes sleeper accommodation.
d. Calculated from the cost and distance measures referenced in Tables 5.18 and 5.20.
e. Cost per mile estimates were calculated, for each respondent, from their reported travel cost and journey distance.
f. "Accuracy" was defined for each respondent by $\frac{|R - E|}{R} \times 100.0$
where R = "real" cost per mile
E = estimated cost per miles
For this section of the analysis, "real" cost per mile for car was defined as the mean estimated cost per mile for each route.

TABLE 5.22 Estimates of Travel Speed[a]

Travel Mode	Journey[b]	Class	Published speed[c]	Number of Estimates	Range	Mean Estimate[d]	Mean Accuracy[e]
Aeroplane	Kuala Lumpur to Singapore	-	243	43	80-666	310.9	35.7
Aeroplane	Kuala Lumpur to Georgetown	-	258	21	66-1000	360.8	55.1
Bus	Kuala Lumpur to Kota Baharu	-	30	55	26-43	39.4	30.2
Bus	Kuala Lumpur to Ipoh	-	31	14	29-56	32.7	11.1
Car	Kuala Lumpur to Ipoh	-	-	77	15-80	43.3	14.8
Car	Kuala Lumpur to Georgetown	-	-	47	18-150	42.1	22.3
Car	Georgetown to Alor Setar	-	-	11	24-43	36.6	15.0
Taxi	Kuala Lumpur to Ipoh	-	54	11	33-56	43.5	20.3
Train	Kuala Lumpur to Butterworth	-	28	41	14-60	28.7	18.4
Train	Kuala Lumpur to Singapore	-	32	30	10-57	29.1	16.5
Train	Butterworth to Singapore		24	11	10-50	24.2	25.9

a. All speeds expressed in miles per hour.
b. Includes reverse journeys.
c. Calculated from the time and distance measures referenced in Tables 5.19 and 5.20.
d. Speed estimates were calculated, for each respondent, from their reported travel time and travel distance.
e. "Accuracy" was defined for each respondent by $\frac{|R - E|}{R} \times 100.0$ where R = "real" speed, E = estimated speed

For this section of the analysis, "real" speed for car was defined as the mean estimated speed for each route.

here.[1] Of the cost-per-mile estimates, only the taxi and the Kuala Lumpur - Kota Baharu bus routes had an overall average error of less than 10 per cent. In both cases the original reports of travel time were exceptionally accurate. Motorists' estimates of unit costs covered a wide range and, when compared with the mean estimate in each case, generated a substantial average error. Furthermore the mean estimates would seem to be quite unrealistic in relation to the figures of 22.1 and 34.1 cents per mile for a small and a large car respectively quoted by Nathan Associates.[2] Mode-choice decisions by these motorists apparently had a "built-in" bias towards their own vehicle. Levels of accuracy were also poor for the computed estimates of speed and air travellers, with "reports" going as high as 1000 miles per hour, were particularly inaccurate.

The preceding analysis concentrated on particular routes where a sufficient number of observations were available to permit meaningful comparisons of "real" values and mean estimates. Attention now turns to an assessment of the overall accuracy of the respondents' knowledge of time, cost

1. One wonders how independent estimates of cost-per-mile and speed would have compared with the "estimates" calculated from the time cost and distance reports.
2. Nathan Associates (1968), Volume 3, Annex B, Exhibit B-31, p.135. These calculations of operating costs were based, respectively, on a Fiat 600 and a Volvo 144 assuming that they were driven 10,000 miles in a year. One factor in the difference between the calculated and estimated costs lies in the particular elements that were included. Lansing and Hendricks (1967) reported that people who had estimated the cost of driving to work usually did not include depreciation in their estimate. Information given by a small number of the In-transit Survey motorists suggests that estimates concentrate on direct vehicle costs: tyres, fuel, oil, lubrication and maintenance. Nathan Associates' figures for these elements, 6.56 and 11.35 cents per mile respectively, come close to the estimates summarised in Table 5.21.

and distance.[1] The summary measures presented in Table 5.23 incorporate all of the valid responses to the estimation question and thus cover a much wider range of travel circumstances than was represented in Tables 5.18 and 5.22.

At first glance these summary results seem to strike a blow at any theory of behaviour that incorporates the assumption of "economic man". Not only do the reported estimates of travel cost deviate markedly from the actual values but cost is also shown to be the least accurate of the three basic measures. It is clear, however, that much of the overall inaccuracy in knowledge of travel costs stems from the analysis of estimates supplied by motorists where no meaningful "objective" value was available for the evaluation of individual estimates. For the public modes of transport, except perhaps train, the respondents' knowledge of travel cost seems remarkably good. Despite the problems involved in making fair assessments of the time reports and in analysing the data from motorists (and motorcyclists) the level of accuracy in these estimates was very even across the six modes. Taxi users were, on average, the most accurate on this measure. Distance estimates also revealed comparable degrees of accuracy among the modes except in the case of aeroplane where the average error was nearly 40 per cent.[2] The effect of this group is to make the distance measure slightly less accurate

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1. Plotting the mean accuracy measures presented in Tables 7.18 to 7.22 against the corresponding "real" values revealed no systematic tendency for accuracy to increase or decrease with the magnitude of the "real" value.
2. One possible explanation for the poor performance of the air respondents could lie in the disorientation of experiencing flight in three dimensions but attempting to gauge distances measured in two.

TABLE 5.23 <u>Accuracy of Transport Knowledge: Summary</u>

	All Modes		Aeroplane		Bus		Car		Motorcycle		Taxi		Train	
	N^a	$\bar{X}^b$	N^a	$\bar{X}^b$	N^a	$\bar{X}^b$	N^a	$\bar{X}^b$	N^a	$\bar{X}^b$	N^a	$\bar{X}^b$	N^a	$\bar{X}^b$
COST	439	18.6	96	6.7	93	6.7	153	34.7	3	33.3	13	2.7	101	17.4
TIME	484	15.1	106	17.1	93	15.9	159	15.1	3	10.3	13	20.4	110	12.1
DISTANCE	438	15.5	80	39.8	84	9.0	160	8.1	3	5.7	13	4.9	98	15.0
COST PER MILE	406	26.0	64	29.4	84	13.3	153	32.9	3	33.9	13	7.3	89	26.1
SPEED	435	24.0	79	47.2	84	25.2	158	16.7	3	11.2	13	18.4	98	17.1
COST-TIME-DISTANCE	1361	16.4	262	21.0	270	9.9	472	19.1	9	16.4	39	9.3	309	14.8
ALL MEASURES	2202	19.6	405	27.4	438	13.5	783	21.3	15	18.9	65	10.7	496	17.3

a. N - Number of valid responses.

b. $\bar{X}$ - Mean accuracy measure. Accuracy was defined for each respondent by $\left|\frac{R - E}{R}\right| \times 100.0$
where R = "real" value
E = estimated value
To permit comparisons with the other models the "real" value for the car and motorcycle responses was defined as the mean estimated value.

overall than time. Without the air travellers the distance reports would have revealed an average error of only 10.3 per cent.

Predictably, the composite "estimates" of cost-per-mile and speed were less accurate overall than the basic measures. But they make no difference to the rank ordering of the modes according to the overall accuracy of the knowledge respondents had about them. Aeroplane was the least accurately known and car, with an average error of nearly 20 per cent over the three measures, was almost as bad.[1] Taxi knowledge was found to be the most accurate, though the results were obtained from a relatively small group of respondents. The bus travellers had the second highest level of accuracy but it has been noted above that many of them did receive some assistance when completing the questionnaire.

This section has discussed the results of a crude attempt to measure the degree to which transport knowledge fits the "facts" of reality. Despite some obvious imprecision particularly in the definition of the "real" time for particular journeys and in determining the "real" values for the private modes of transport, it is clear that the respondents' knowledge of travel time, travel cost, and journey distance reveals substantial margins of error. This conclusion is emphasised when it is recalled that each respondent supplied estimates for only one mode, that these estimates concerned a very recent (or current) journey and that each respondent could very easily have researched his

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1. It should be clear that knowledge of car is made to appear less accurate than it really is by the assumption of a single "real" value for each route.

estimates. General knowledge of transport modes would appear likely to involve at least an average error of 10 per cent.

5.6 Summary

Chapter Five has examined the images of transport modes held by the people who responded to one or other of two questionnaire surveys. Although the results of the analyses undertaken can in no way be statistically generalised to a wider population of actual or potential travellers in Malaya some major points deserve emphasis. Measurements of mode images by means of a semantic differential instrument generated distinct and apparently meaningful representations of the six modes examined. Discussion of the "average" images indicated those criteria on which particular modes were seen to be very similar and thus in close competition. The same analysis also helped to highlight the attributes that gave any mode an advantage over the others or where it suffered in comparisons. It would seem that this kind of information provides a much stronger base for the planning and development of transport facilities than could be obtained from a frequency distribution of mode descriptors. Respondent to respondent variation of images within a particular mode revealed few systematic relationships with the personal characteristics of the people studied. The only notable sources of variation focussed on the school pupil - university student - government employee distinction and on groupings by age. Together, these appeared to index a "behavioural maturity dimension". Variables such as vehicle ownership and travel experience that were expected to generate differing mode images appeared to have little effect in the data analysed. Such results serve to emphasise the inherent individuality of mode images and the problems of assuming that similar people necessarily have similar ideas about their environment. Independent measures of mode knowledge showed that respondents could be very wrong in their estimates of travel time, travel cost or journey distance and that one should expect an average error of well over 10 percent in general knowledge of travel modes.

The concept of the mode "image", and the procedures by which it was made operational, clearly have the potential to provide much insight into mode-choice decisions and the travel patterns that they generate. At the same time, however, the very considerable inter-individual variation in the measured images raises the essential question of whether or not these data really do tap the mental processes involved in mode-choice decisions. Do the measurements adequately represent the ideas, feelings and beliefs that influence the individual when he chooses a mode? Chapter Six seeks to answer this question by using the mode images measured for each respondent in an attempt to reproduce the mode preference rankings reported by that respondent. If the rankings can be reproduced then one can have confidence in the validity of the measured mode images.

CHAPTER SIX: MODELLING THE MODE-CHOICE DECISION

Any decision made by a human actor depends on that actor's knowledge of, opinions on and attitudes toward the circumstances that constitute the decision situation and the alternative courses of action available in that situation. For this study the knowledge, or image, possessed of selected modes of transport was operationally defined by a semantic differential. Chapter Five focussed on a description of the mode images held by the study group, examined the hypothesis that images would vary systematically according to the personal characteristics and travel experience of the individual and investigated the accuracy of knowledge of certain aspects of mode images. Having defined the nature and extent of existing transport knowledge, attention now shifts to an examination of the procedures by which that knowledge is utilised in making a mode-choice decision.

Initial reference is made to the earlier discussion of the modes that emerged with the most (or least) favourable mean ratings on each scale of the semantic differential instrument (Section 5.2). Aeroplane, for example, was perceived as the fastest, cleanest and most comfortable of the six modes examined but in terms of punctuality, accessibility and ease of taking luggage first place went to car. Train was seen as the safest mode of inter-city travel while motorcycle was rated as the cheapest. Examining individual scales in this manner is of considerable interest but it does not lead much closer to an understanding of actual mode decisions. It is clear that the decision maker can, and does, perceive alternative modes of transport in terms of a number of (apparently) discrete characteristics (descriptors or attributes). Yet it is equally obvious that, in order to select the "best" mode for a particular journey, he must also combine the various elements of each mode image to arrive at some overall assessment that represents his integrated attitude toward that mode for the journey about to be undertaken. This "overall assessment" can then be compared with the equivalent assessments obtained for the other modes, with the most favourable of these assessments indexing the mode actually selected for use. The present chapter is concerned, therefore, with the examination of a family of simple numerical models for deriving this "overall assessment" for each mode and hence predicting the mode-choice that would be made by each individual, given the reported mode images.

Models, such as the ones presented here, are of little use unless they can be judged against the reality they purport to simplify. As the Mode Image Survey was not tied to an actual mode-choice situation, reality in this case is represented by each respondent's ranking of the six modes in the order that he or she would choose them for a specified journey. To avoid confusion, this ranking is termed the mode preference ranking. Comparison of the rank order predicted by the model with the mode preference ranking reported by each respondent provides a ready test of the decision model.

6.1 Mode Preference Rankings

Defining "reality" in terms of the mode preference rankings does overcome the problems of time lag and recall that can arise when attempts are made to investigate and explain behaviour that occurred some time previous to actual data collection. In this case the "behaviour" (preference rankings) and the "explanation" (mode image measurements) occurred at essentially the same point in time. There is, therefore, no problem of recall of past behaviour and no risk that change might have taken place in the bases of explanation between the time of behaviour and the time of data collection. It should be admitted, however, that the procedure adopted could be unrealistic in the sense that the "behaviour" (mode preference rankings) did not have to be implemented by the respondent. The preference rankings could well incorporate some element of "wishful thinking" where a respondent might give preference to some highly desirable mode that he was unlikely to use in real life. In an attempt to counteract this possibility and to avoid seeking meaningless "general" preferences, the context of the mode preference question was carefully structured with respect to trip purpose and journey destination. Two trip purposes (business and holiday) and three journey destinations (Penang, Singapore and, for those who lived outside the state of Selangor, Kuala Lumpur) were used. Thus a particular respondent might have reported mode preference rankings with regard to a "business trip to Singapore" or a "holiday trip to Penang".[1] All six combinations of the two trip purposes and the three journey destinations were used and particular arrangements were randomised among questionnaires during distribution. Before attention turns to the operation of the choice model itself the mode

1. See Appendix 3a for the actual wording of this question.

preference rankings will be described in terms of the "average" preference for each mode and the extent to which respondents were in agreement with that average value.[1,2]

Although aeroplane was the mode most frequently given first rank it also received a substantial number of low ranks and as many as 32 respondents rated aeroplane in last place (Table 6.1). Consequently its mean rank of 2.5 is much lower than might have been expected.[3] This is, in fact, less favourable than the corresponding mean value for car which was either first or second preference for more than three-quarters of the respondents. The finding is corroborated by using the standard deviation as an index of the extent to which respondents' preferences varied around the mean ranking. Closest agreement, overall, was shown in the rankings of car while those for aeroplane revealed most variability. The mean ranks for the remaining modes reflected relatively close agreement among respondents. Preferences for motorcycle concentrated strongly on last place and the mode emerged with the least favourable mean rating of all, nearly a whole rank position behind bus. Average preference rankings for taxi and train were quite similar with train rating slightly more favourable but

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1. Of the 257 questionnaires examined for the discussion of mode images in Chapter Five, thirteen had incomplete mode preference rankings and so they have been excluded from all of the analyses reported in the present chapter. Deletion of these thirteen respondents made very little difference to the overall mode images.
2. Calculation of arithmetic means and standard deviations requires the assumption of at least interval measurement. Rank order data does not normally meet this requirement but the assumption is made here to facilitate a brief description of the ranking patterns.
3. Where 1 indicates first preference and 6 the least preferred of the six modes studied.

TABLE 6.1 Mode Preference Rankings: All Respondents

	Mode						
	Aeroplane	Bus	Car	Motor-cycle	Taxi	Train	Total
Frequency Distribution							
Rank							
1 (first preference)	125	5	87	3	4	20	244
2	30	7	106	9	47	45	244
3	19	39	33	3	76	74	244
4	16	40	11	16	86	75	244
5	22	123	5	43	25	26	244
6 (last preference)	32	30	2	170	6	4	244
Mean Rank[a]	2.5	4.5	2.0	5.4	3.4	3.2	
Standard Deviation[a]	1.9	1.1	1.0	1.1	1.1	1.2	
Percentage Distribution[b]							
Rank							
1 (first preference)	51.2	2.0	35.7	1.2	1.6	8.2	99.9
2	12.3	2.9	43.4	3.7	19.3	18.4	100.1
3	7.8	16.0	13.5	1.2	31.1	30.3	99.9
4	6.6	16.4	4.5	6.6	35.2	30.7	100.0
5	9.0	50.4	2.0	17.6	10.2	10.7	99.9
6 (last preference)	13.1	12.3	0.8	69.7	2.5	1.6	100.0

a. Calculated by scoring modes in terms of the number used to identify each rank.
b. Percentages indicate the proportion of responses that allocated the given rank to a particular mode. Because of rounding percentages do not always sum to 100.0.

showing a little less agreement among respondents.

Although Table 6.1 gives the frequency with which a given mode attained a particular rank it does not necessarily indicate the relative rank positions of the modes for individual respondents. This was examined by isolating those ranking patterns that recurred most frequently among the mode preferences reported by the study group. Of the 90 ranking patterns contained within the data, two in particular stand out and between them cover 57 of the 244 respondents. Thirty people recorded the preference ordering (from first to last): aeroplane, car, train, taxi, bus and motorcycle, while another 27 repeated this pattern changing only the relative positions of taxi and train. It is noticeable that neither of these patterns coincides with the ordering derived from the mean mode ranks where car took first place. The third most frequent pattern covered twelve people and differed from the main sequence only in a reversal of the positions of train and car.

Mode preference rankings for the two trip types examined are set out in Tables 6.2 and 6.3. Judged on the basis of the calculated mean ranks the two trip types generated quite different mode preferences. Aeroplane was clearly overall first preference for "business trips" yet the magnitude of the standard deviation suggests that there was still some divergence of opinion over this ranking. Car took second place followed by train, taxi, bus and motorcycle. Respondents showed particularly strong agreement on the ranking for motorcycle. In the case of "holiday trips", however, calculation of the mean preference ranking left aeroplane in

TABLE 6.2 Mode Preference Rankings: Business Trips Only

	Mode						
	Aeroplane	Bus	Car	Motor-cycle	Taxi	Train	Total
Frequency Distribution							
Rank							
1 (first preference)	84	2	26	0	2	7	121
2	13	3	61	1	24	19	121
3	7	9	25	1	38	41	121
4	4	17	6	6	44	44	121
5	6	74	2	19	10	10	121
6 (last preference)	7	16	1	94	3	0	121
Mean Rank[a]	1.8	4.7	2.2	5.7	3.4	3.3	
Standard Deviation[a]	1.5	1.0	0.9	0.7	1.0	1.0	
Percentage Distribution[b]							
Rank							
1 (first preference)	69.4	1.7	21.5	-	1.7	5.8	100.1
2	10.7	2.5	50.4	0.8	19.8	15.7	99.9
3	5.8	7.4	20.7	0.8	31.4	33.9	100.0
4	3.3	14.0	5.0	5.0	36.4	36.4	100.1
5	5.0	61.2	1.7	15.7	8.3	8.3	100.2
6 (last preference)	5.8	13.2	0.8	77.6	-	-	99.9

a. Calculated by scoring modes in terms of the numbers used to identify each rank.
b. Percentages indicate the proportions of responses that allocated the given rank to a particular mode. Because of rounding percentages do not always sum to 100.0.

TABLE 6.3 Mode Preference Rankings: Holiday Trips Only

	Mode						
	Aeroplane	Bus	Car	Motor-cycle	Taxi	Train	Total
Frequency Distribution							
Rank							
1 (first preference)	41	3	61	3	2	13	123
2	17	4	45	8	23	26	123
3	12	30	8	2	38	33	123
4	12	23	5	10	42	31	123
5	16	49	3	24	15	16	123
6 (last preference)	25	14	1	76	3	4	123
Mean Rank[a]	3.2	4.2	1.8	5.2	3.4	3.2	
Standard Deviation[a]	2.0	1.2	1.1	1.3	1.1	1.3	
Percentage Distribution[b]							
Rank							
1 (first preference)	33.3	2.4	49.6	2.4	1.6	10.6	99.9
2	13.8	3.3	36.6	6.5	18.7	21.1	100.0
3	9.8	24.4	6.5	1.6	30.9	26.8	100.0
4	9.8	18.7	4.1	8.1	34.1	25.2	100.0
5	13.0	39.8	2.4	19.5	12.2	13.0	99.9
6 (last preference)	20.3	11.4	0.8	61.8	2.4	3.3	100.0

a. Calculated by scoring modes in terms of the numbers used to identify each rank.
b. Percentages indicate the proportion of responses that allocated the given rank to a particular mode. Because of rounding percentages do not always sum to 100.0.

third position behind both car and train. The respondents again exhibited relatively little agreement in their ranking of aeroplane. Taxi, bus and motorcycle took the last three mean preference positions for "holiday trips" as well as for "business trips" and both trip types taken together.

The apparent impact of trip type on mode preference rankings can be put in better perspective by using a multivariate analysis of variance model (MANOVA) to test the effect of trip definition, personal characteristics and travel experience variables on reported mode preferences. As the 244 respondents cannot validly be considered as a sample of some population the results are again presented in terms of eta-square (Table 6.4).[1] Trip type did emerge as one of the important sources of variation in preference ranks (fifth largest eta-square of the 19 variables tested) but the analysis directs attention back to the notion of behavioural maturity suggested in Section 5.4. The two major sources of variation were again the "place of employment" variable and age but the steady progression, positive or negative, in mean scale ratings from "school" to "university" to "government" (or "under twenty" to "twenties" to "thirty and over") was not repeated here. Instead the "university" group tended to have a markedly more or less favourable attitude to particular modes than the other two groups. Mean rankings of car, for instance, were 1.66 for "university", 1.86 for "government" and 2.43 for "school" while those for aeroplane were, respectively, 3.26, 2.08 and 2.06. Ranking patterns within

1. See Section 5.3 for a discussion of the MANOVA model and eta-square.

TABLE 6.4 Sources of Variation in the Mode Preference Rankings

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Main Modes (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (121), Holiday (123)	.156	Aeroplane (.13), Motorcycle (.05)
Trip Destination	3	Kuala Lumpur (27), Penang (102), Singapore (115)	.048	Train (.03), Aeroplane (.01)
Trip Destination[c]	2	Penang (102), Singapore (115)	.014	Bus (.01), Taxi (.00)
Personal Characteristics				
Age	3	Under 20 (70), Twenties (114), 30 and over (58)	.220	Car (.09), Train (.08)
Sex	2	Female (38), Male (202)	.042	Train (.02), Motorcycle (.01)
Occupation[d]	3	Professional (61), Clerical (84), Production (29)	.086	Taxi (.03), Car (.03)
Occupation[e]	3	School (65), University (65), Government (78)	.258	Car (.10), Aeroplane (.09)
Ethnic Group	3	Malay (77), Chinese (109), Other (53)	.070	Bus (.03), Aeroplane (.02)
Ethnic Group[f]	2	Malay (77), Chinese (109)	.043	Aeroplane (.03), Train (.02)
Income	3	\$0-\$300 (69), \$301-\$750 (68), Over \$750 (67)	.190	Motorcycle (.10), Car (.05)
Car Ownership	2	Car (102), No Car (142)	.069	Motorcycle (.03), Train (.02)
Motorcycle Ownership	2	Motorcycle (67), No Motorcycle (177)	.128	Motorcycle (.07), Taxi (.06)
Travel Experience				
Aeroplane	2	None (160), Some (56)	.011	Motorcycle (.00), Taxi (.00)
Bus	3	None (35), 1-5 trips (75), Over 5 (110)	.052	Motorcycle (.02), Bus (.02)
Car	3	None (28), 1-5 trips (58), Over 5 (139)	.132	Car (.09), Motorcycle (.03)
Motorcycle	3	None (102), 1-5 trips (61), Over 5 (52)	.190	Motorcycle (.16), Aeroplane (.05)
Taxi	3	None (25), 1-5 trips (89), Over 5 (113)	.077	Train (.04), Motorcycle (.02)
Train	3	None (51), 1-5 trips (97), Over 5 (79)	.041	Train (.02), Car (.01)
Total Travel Experience	3	None (29), 1-10 trips (40), Over 10 (175)	.022	Train (.02), Aeroplane (.01)

(contd)

TABLE 6.4/contd.

a. N - Number of groups input to each analysis.
b. Because some respondents did not provide certain details the total number of observations entering a particular analysis might not total 244.
c. Analysis was repeated to exclude respondents resident outside Selangor.
d. Full description of the groups is: Professional, Technical, Administrative and Managerial; Clerical, Sales and Service; Production Workers and Labourers (See Table 3.5 for further details).
e. As the occupation coded for a student was that of his father or guardian interpretation of the results could be misleading. The analysis was therefore repeated with each respondent grouped according to his "place of employment".
f. Analysis was repeated to exclude the heterogeneous "Other" grouping.

the age variable were almost identical with those revealed for the "place of employment" variable. At the other end of the scale it is interesting to note that trip destination was among the least important sources of variation in mode preference rankings.

These preference rankings, then, represent the "reality" against which the predictions of the choice model are to be judged. The remarkable range in preferences reported for individual modes (as revealed in Table 6.1) makes it clear that the model is not merely being asked to predict the obvious.

6.2 The Primary Model (Model I)

An initial step toward the construction of a numerical model to predict individual mode-choice decisions can be taken by using a very simple procedure to combine the various elements of each mode image into an overall assessment of the "worth" of that mode. It will be recalled that the mode image data were collected by asking respondents to rate each of the six modes on a series of seven point scales. A particular respondent might have rated car 3 and bus 5 on the fast-slow scale. Similarly he could have given these two modes the ratings 3 and 2 respectively on the cheap-expensive scale. As the semantic differential generates interval level data these ratings can be added to provide a summary assessment of the two modes according to the way they were seen by this respondent.[1] In this case the total achieved

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1. Osgood et. al.; 1957, pp.146-153. See also Heise (1969).

by car, 6, is "better" than the 7 scored by bus and so the model would predict that car is preferred to bus.[1] The Primary Model described here is expanded from this simple 2 mode, 2 scale example to summations over all 21 scales for each of the 6 modes.[2] Crude as it is, the Primary Model helps set the scene for the more "sophisticated" variants to be discussed in later sections.

For this model, and all of the others examined in this study, the principal output for every respondent consists of the "total score" calculated for each of the six modes. A "mean mode score" was then calculated to take account of "irrelevant scale" responses and to establish the basis for defining the predicted rank order.[3] As the mode image values were coded from 1 (most favourable) to 7 (most unfavourable) the smallest mean mode score identified the mode predicted in first rank, the second smallest indicated the second rank mode and so on until the largest value defined the last choice mode. This order-of-choice predicted by the model for each respondent is evaluated in two main ways. The first simply compares the predicted first choice mode with the stated first preference mode. If the two modes match then the model achieved a correct prediction. The second procedure takes a broader view of model performance. It checks the entire predicted rank order against the full

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1. Note that the scoring of the mode image data was made uniform before analysis started so that all scales ranged from 1 most favourable to 7 least favourable (Section 5.2).
2. See Section 2.2.3.3 and Table 2.2 for a precise definition of the Primary Model.
3. The mean mode score was defined by dividing the total mode score by the number of valid (non-zero) mode image values that contributed to the total mode score (See Table 2.2).

preference order by calculating the Spearman rank order correlation coefficient (rho) to indicate the degree of "fit" between the two sets of ranks.[1] These two measures are calculated for each respondent. Over all respondents model performance is evaluated by (1) the proportion of predictions that achieved a match between the predicted first choice mode and the first preference mode, (2) the mean of the distribution of rho values and (3) the number of cases that achieved perfect predictions (ρ = +1.0).

Table 6.5 sets out the results obtained from the Primary Model.

At first glance the "score" of seven perfect predictions out of 244 respondents would hardly seem to be an outstanding result. Yet there is considerable evidence that the model has revealed a simple and rational connection between the measured mode images and the stated mode preferences. Only in 6.9 per cent of the cases was the predicted choice negatively related to the reported preferences while 59.5 percent obtained a fit between stated and predicted of

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1. The Spearman rank order correlation coefficient (rho) is given by

$$\rho = 1 - \frac{6\sum d_i^2}{N^3 - N}$$

where d_i = the difference between the predicted rank and the preference rank for the i th mode

N = the number of modes

Rho varies from ρ = +1.0 (indexing a perfect fit between actual and predicted ranks through ρ = 0.0 (representing no relationship between the two) to ρ = -1.0 (a perfectly wrong prediction that inverted the preference order). See Siegel, 1960, pp.202-213.

Table A5.6 in Appendix 5c gives the distributions of rho for all possible rank orders when four, five and six modes are evaluated. Some tangible meaning is given to intermediate values of rho in Table A5.7 which lists the rank orders that generate selected rank order correlation coefficients.

TABLE 6.5 Primary Model (Model I): Results

Rho	Frequency	Percent
-1.00 to -0.81	2	0.8
-0.80 to -0.61	0	0.0
-0.60 to -0.41	2	0.8
-0.40 to -0.21	5	2.0
-0.20 to -0.01	8	3.3
0.00 to +0.19	15	6.1
+0.20 to +0.39	32	13.1
+0.40 to +0.59	35	14.3
+0.60 to +0.79	79	32.4
+0.80 to +0.99	59	24.2
1.00	7	2.9
Total	244	99.9

Mean Rho	0.566
Standard Deviation	0.496
Coefficient of Variability	87.6 percent

First Preferences By Predicted Rank

Rank Predicted	Frequency	Percent
1	112	45.9
1.5	2	0.8
2	69	28.3
2.5	1	0.4
3	25	10.2
3.5	2	0.8
4	17	7.0
4.5	1	0.4
5	8	3.3
5.5	0	-
6	7	2.9
Total	244	100.0

ρ = 0.600 or greater. Furthermore the mean rho for all respondents was 0.566. More convincing results are obtained by comparing first preferences against first predictions (Table 6.5). Although this reduces the scope of the model it might also be regarded as a more realistic test: in real life second, third and fourth preferences have little meaning if the first choice can be implemented. In the case of the Primary Model more than 45 percent of the first preference modes were correctly predicted and another 29 percent were predicted within 1 rank position. It is clear that the Primary Model is worthy of further examination. This will take two forms: firstly the refinement of the model itself in an attempt to make it more realistic in its approximation to actual decision processes and secondly, the examination of "deviant cases" for clues as to why the model made poor predictions for these respondents.

6.3 A Refined Model

Evidence has already been presented to indicate that a certain scale (or scales) might have no meaning for a particular respondent and so would presumably contribute nothing to a decision made by that person (Section 5.1). The discussion of mode descriptors in Chapter Four showed that travellers do not recognise a common set of mode characteristics. Furthermore it suggested that certain mode attributes (or scales) are more important to travellers than others and that these attributes might carry more weight when making a choice. Clearly, it is necessary to incorporate into the decision model some method of weighting the contribution of individual attributes.

The particular procedure adopted here assumes that each aspect of a mode image (i.e. "Travel Cost", "Comfort", "Safety") is viewed with greater or lesser importance by the decision maker. Thus "Safety" might be seen as an extremely important element in the decision with "Comfort" of minor concern while "Travel Cost" rated intermediate between these two. It is argued that each traveller would have his own personal views on the relative importance of each mode attribute. During the Mode Image Survey, therefore, each respondent was asked to rate, on a five point scale, the relative importance he would attach to each of the various mode characteristics when making a mode-choice decision (Appendix 3). Such importance ratings can be given numerical weights. Multiplying the value given to each aspect of a mode image by its appropriate weight and summing over all scales generates an "adjusted" and more realistic total "value" for each mode.[1] Thus if Bus was rated 3 (slightly comfortable) on the "comfortable seats-uncomfortable seats" scale and "Seating Comfort" was given an importance weight of 2 (quite important) by the same respondent, then the comfort attribute would contribute 3 x 2 = 6 to the total "value" of Bus. The procedure is repeated for each mode and the one with the lowest total "value" (or highest subjective utility) is the mode identified as best or most suitable by the decision model.[2] Ranking the modes on the basis of these

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1. This total "value" can be regarded as a surrogate estimate of the subjective utility of a particular mode for the respondent concerned. Section 2.2.3.3 and Table 2.2 provide the definition of this model.
2. It should be recalled that, under the systems of scaling adopted here, a numerically small total "value" represents relatively high subjective utility.

total "value" scores provides the predicted order of choice. For each respondent the measured mode images and the ratings of attribute importance constitute the inputs to the decision model. The predicted order of mode-choice output by the model is tested against the respondent's mode preference ranking. Chapter Five examined the reported mode images and so, before turning to the operation of the decision model itself, discussion focusses on the attribute importance ratings reported by respondents.

6.4 Attribute Importance Ratings

Each respondent to the Mode Image survey was asked to indicate the importance that he or she would attach to various mode qualities when selecting a mode for a specified journey. These importance ratings were made on a five point scale ranging from "Very Important" to "Very Unimportant".[1] All of the mode attributes used as scales in the semantic differential instrument were rated in this manner except than an error in printing the questionnaire meant that importance ratings were not obtained for "Safety" and "Relaxation". Table 6.6 sets out the distribution of responses for the remaining 19 mode attributes. Mean rating scores and standard deviations have been calculated to summarise these details.[2]

It is immediately apparent that the mean ratings are

1. See Appendix 3a for the actual wording of this question and the full importance scale. Table A5.8 in Appendix 5d gives details on the patterns of response for this scale.
2. The importance scale was worded symmetrically after the semantic differential pattern to ensure the interval measurements required for these operations.

TABLE 6.6 Attribute Importance: All Respondents

Mode Attribute	Importance Rating[a] A	B	C	D	E	Mean Rating[b]	Standard Deviation[b]
Cost	80	86	46	21	11	2.17	1.11
Travel Time	102	92	25	18	7	1.92	1.03
Flexibility	94	82	36	24	8	2.06	1.10
Convenience	101	108	15	12	8	1.84	0.97
Speed	57	126	44	13	4	2.10	0.87
Seating Comfort	96	109	25	12	2	1.83	0.86
Smooth Riding	90	116	25	10	3	1.85	0.85
Waiting	110	82	29	17	7	1.89	1.05
Ventilation	78	93	38	20	15	2.18	1.15
Accessibility	56	121	46	15	6	2.16	0.93
Cleanliness	91	117	24	10	2	1.83	0.83
Timetabling	122	92	20	8	2	1.67	0.82
Scenery	25	83	82	38	16	2.74	1.05
Spaciousness	66	108	38	25	7	2.18	1.03
Crowding	91	98	32	14	9	1.98	1.03
Taking Luggage	63	124	32	20	5	2.10	0.94
Noise	56	91	55	28	14	2.40	1.13
Punctuality	112	89	23	12	8	1.83	1.01
Social Status	12	71	94	49	18	2.96	0.99

a. Importance Ratings: A - Very Important
B - Quite Important
C - Neither Important nor Unimportant
D - Quite Unimportant
E - Very Unimportant

b. Calculated by scoring the rating Very Important as 1, Quite Important as 2 and so on to Very Unimportant scored as 5.

remarkably uniform. No attribute stands out as being exceptionally important overall and only the least influential attribute, "Social Status", dropped below an intermediate rating when averaged. "Timetabling" emerged as the most important attribute and, with half of the respondents giving it the highest rating, revealed the strongest consensus of opinion. Three attributes, "Seating Comfort", "Cleanliness" and "Punctuality", obtained the same mean rating to be next in line of importance although they were closely followed by "Convenience" and "Smooth Riding". At the other end of the scale "Noise", "Scenery" and "Social Status" rated somewhat lower in importance than the other attributes. Strangely enough for a survey undertaken in a tropical country the respondents exhibited the least agreement with their ratings of the importance accorded to "Ventilation"!

The order of importance identified by these mean ratings bears little resemblance to the order derived from the frequency distribution of mode-choice reasons and mode disadvantages (Chapter Four). "Cost", the second most frequently mentioned descriptor, ranks only fourteenth out of 19 according to the importance ratings. It has been argued, however, that attribute importance could vary according to the nature of the journey for which the selected mode was to be used. As respondents were asked to provide the importance ratings with respect to a specified type of journey this point is easily examined. Tables 6.7 and 6.8 display the distribution of ratings for Business Trips and Holiday Trips respectively.

For Business Trips most weight was again given to

TABLE 6.7 Attribute Importance: Business Trips Only

Mode Attribute	Importance Rating[a] A	B	C	D	E	Mean Rating[b]	Standard Deviation[b]
Cost	36	36	26	15	8	2.36	1.21
Travel Time	61	44	5	7	4	1.75	1.01
Flexibility	38	44	23	13	3	2.17	1.06
Convenience	53	49	8	6	5	1.85	1.03
Speed	36	64	13	5	3	1.97	0.89
Seating Comfort	40	58	14	8	1	1.94	0.88
Smooth Riding	42	60	14	3	2	1.87	0.83
Waiting	61	39	14	4	3	1.75	0.96
Ventilation	34	49	22	9	7	2.22	1.11
Accessibility	28	59	22	8	4	2.18	0.97
Cleanliness	40	56	17	6	2	1.96	0.90
Timetabling	79	35	6	1	0	1.41	0.63
Scenery	7	24	49	26	15	3.15	1.06
Spaciousness	30	49	23	13	6	2.31	1.10
Crowding	39	52	17	9	4	2.07	1.03
Taking Luggage	28	56	19	15	3	2.25	1.02
Noise	26	39	31	18	7	2.51	1.15
Punctuality	70	35	7	5	4	1.66	0.99
Social Status	5	38	44	25	9	2.96	0.99

a. Importance Ratings: A - Very Important
B - Quite Important
C - Neither Important nor Unimportant
D - Quite Unimportant
E - Very Unimportant

b. Calculated by scoring the rating Very Important as 1, Quite Important as 2 and so on to Very Unimportant scored as 5.

"Timetabling" (with particularly close agreement among respondents) followed by "Punctuality", "Travel Time" and "Waiting". This time "Scenery" emerged as the least important attribute some way behind "Social Status". "Cost" slipped to sixteenth position with a much smaller importance rating than in the "all trips" analysis and with the most marked divergence of opinion of all the Business Trip ratings. With respect to the choice of mode for Business Trips, then, the respondents clearly put most emphasis on those mode attributes contributing to the most efficient use of the traveller's time.

The order of importance changes substantially when Holiday Trips are considered (Table 6.8). Concern moves away from the mode performance attributes indexed above to the more personal correlates of travel. Most importance was given to "Cleanliness" with "Seating Comfort" only marginally behind and then "Convenience" and "Smooth Riding". Ratings of "Cost" reflect its enhanced importance for this type of trip and this attribute occupies ninth position. Least weight is given to "Social Status" but it is somewhat surprising that "Scenery" should rate second to last for Holiday Trips. The respondents seemed to be more interested in conditions within the travel vehicle than in watching the countryside as it passed by.

The apparent impact of trip type on attribute importance can be gauged with more precision and can be put into perspective with other possible sources of variation by again adopting the multivariate analysis of variance model. As before attention is directed mainly to the value of eta-square

TABLE 6.8 Attribute Importance: Holiday Trips Only

Mode Attribute	Importance Rating[a] A	B	C	D	E	Mean Rating[b]	Standard Deviation[b]
Cost	44	50	20	6	3	1.98	0.97
Travel Time	41	48	20	11	3	2.08	1.03
Flexibility	56	38	13	11	5	1.95	1.13
Convenience	48	59	7	6	3	1.84	0.91
Speed	21	62	31	8	1	2.24	0.84
Seating Comfort	56	51	11	4	1	1.72	0.82
Smooth Riding	48	56	11	7	1	1.84	0.87
Waiting	49	42	15	13	4	2.03	1.11
Ventilation	44	44	16	11	8	2.15	1.19
Accessibility	28	62	24	7	2	2.13	0.88
Cleanliness	51	61	7	4	0	1.71	0.72
Timetabling	43	57	14	7	2	1.93	0.91
Scenery	18	59	33	12	1	2.34	0.87
Spaciousness	36	59	15	12	1	2.05	0.94
Crowding	52	46	15	5	5	1.90	1.03
Taking Luggage	35	68	13	5	2	1.95	0.83
Noise	30	52	24	10	7	2.28	1.09
Punctuality	42	54	16	7	4	2.00	1.00
Social Status	7	33	50	24	9	2.96	0.99

a. Importance Ratings: A - Very Important
B - Quite Important
C - Neither Important nor Unimportant
D - Quite Unimportant
E - Very Unimportant

b. Calculated by scoring the rating Very Important as 1, Quite Important as 2 and so on to Very Unimportant scored as 5.

as an index of the overall difference between the attribute ratings reported by one group of respondents and those recorded by another group. Summary results of this analysis are set out in Table 6.9.

These results again draw attention back to the notion of "behavioural maturity" suggested above. It is the School-University-Government distinction, contributing 38 percent of the variance in the importance ratings, that is the most important source of variation. Examination of the eta-square values calculated from the univariate analyses of variance for each attribute again helps pinpoint the main differences among these three groups of respondents. Only two attributes, "Waiting" and "Speed", stand out from the others on this measure. "Waiting", with 15 percent of the variance in its ratings accounted for by the distinction among the School-University-Government "place of employment", was the more important of the two. It revealed a marked increase in the mean importance rating from 2.49 (School) to 1.63 (University) and 1.58 (Government). "Speed" revealed a very similar pattern. The increasing pressures of life with the transition from school to employment are evident in these results. "Cost" also registered a notable increase in mean importance rating from School to University to Government but the distinction contributed only 3 percent of the variance for that attribute. According to the univariate eta-square values "Smooth Riding", "Taking Luggage", "Accessibility" and "Flexibility" varied exceptionally little in importance among respondents from the three "places of employment".

Further backing for the "behavioural maturity"

TABLE 6.9 Sources of Variation in the Attribute Importance Ratings

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Main Scales (Univariate eta-square)
Nature of Trip				
Trip Type	2	Business (121), Holiday (123)	.242	Scenery (.13), Timetabling (.10)
Trip Destination	3	Kuala Lumpur (27), Penang (102), Singapore (115)	.171	Crowding (.03), Flexibility (.02)
Trip Destination[c]	2	Penang (102), Singapore (115)	.113	Crowding (.01), Scenery (.01)
Personal Characteristics				
Age	3	Under 20 (70), Twenties (114), 30 and Over (58)	.298	Waiting (.15), Speed (.08)
Sex	2	Female (38), Male (202)	.085	Timetabling (.05) Travel Time (.01)
Occupation[d]	3	Professional (61), Clerical (84), Production (29)	.183	Timetabling (.03), Scenery (.03)
Occupation[e]	3	School (65), University (65), Government (78)	.383	Waiting (.15), Speed (.09)
Ethnic Group	3	Malay (77), Chinese (109), Other (53)	.234	Spaciousness (.06), Travel Time (.04)
Ethnic Group[f]	2	Malay (77), Chinese (109)	.209	Spaciousness (.07), Cleanliness (.04)
Income	3	$0-$300 (69), $301-$750 (68), Over $750 (67)	.260	Waiting (.05), Timetabling (.03)
Car Ownership	2	Car (102), No Car (142)	.075	Waiting (.02), Spaciousness (.02)
Motorcycle Ownership	2	Motorcycle (67), No Motorcycle (177)	.039	Cost (.01), Waiting (.00)
Travel Experience				
Aeroplane	2	Never (160), Some Experience (56)	.087	Scenery (.02), Waiting (.02)
Bus	3	Never (35), 1-5 trips (75), Over 5 (110)	.184	Scenery (.04), Waiting (.03)
Car	3	Never (28), 1-5 trips (58), Over 5 (139)	.245	Crowding (.07), Noise (.06)

(contd)

TABLE 6.9/contd.

Variable	N[a]	Definition of Groups (Number of Observations)[b]	Overall Eta-square	Main Scales (Univariate eta-square)
Motorcycle	3	Never (102), 1-5 trips (61), Over 5 (52)	.188	Taking Luggage (.04), Scenery (.03)
Taxi	3	Never (25), 1-5 trips (89), Over 5 (113)	.155	Accessibility (.03), Punctuality (.02)
Train	3	Never (51), 1-5 trips (97), Over 5 (79)	.173	Speed (.05), Ventilation (.04)
Total Travel Experience	3	Never (29), 1-10 trips (40), Over 10 (175)	.150	Seating Comfort (.03), Travel Time (.02)

a. N - Number of groups input to each analysis.
b. Because some respondents did not provide certain details the total number of observations entering a particular analysis might not total 244.
c. Analysis was repeated to exclude respondents resident outside Selangor.
d. Full description of the groups is: Professional, Technical, Administrative and Managerial; Clerical, Sales and Service; Production Workers and Labourers (See Table 4.5 for further details).
e. As the occupation coded for a student was that of his father or guardian interpretation of the results could be misleading. The analysis was therefore repeated with each respondent grouped according to his "place of employment".
f. Analysis was repeated to exclude the heterogeneous "Other" grouping.

suggestion is obtained from the second most important source of variation in the attribute importance ratings: the division of respondents among the Age groups "Under 20", "Twenties" and "30 and Over". Here again "Waiting" and "Speed" are the most significant attributes and they repeat the pattern described for the "place of employment" analysis. The Trip Type variable is only the fifth most important source of variation in the importance ratings with Income and Travel Experience by Car also having larger overall eta-square values. Although it might logically be expected that Trip Type would have a major impact on the attribute importance ratings this study has shown it to be outweighed by other considerations. It is also interesting to note the minor effect of the Ownership variables (Own Car, Own Motorcycle), Sex and Travel Experience by Air on the attribute importance ratings. But even in the case of "place of employment" and Age the relationships indexed by the eta-square values cannot really be called strong. Overall, then, one might conclude that the attribute importance ratings were basically personal evaluations rather than being strongly and consistently related to particular characteristics of the individual.

6.5 The Basic Model (Model II)

Using these attribute importance ratings to weight the contribution of each aspect of the measured mode image helps overcome one major fault in the Primary Model: travellers obviously do not give equal weight to each cognised characteristic of a given mode. Another problem emerges, however, in the selection of the actual numerical values of the weights to represent ratings of Very Important, Quite Important, Neither Important nor Unimportant and so on. Under the assumption of an interval importance scale a logical selection would be 1.0, 2.0, 3.0, 4.0 and 5.0 respectively down the importance ratings.[1] It must be admitted that there is little theoretical or empirical justification available for this selection. Other number sets might well lead to more accurate predictions, but such alternative number sets would lead to a circular argument.[2] Consequently, all of the models reported here rely on the intuitively appealing, but theoretically and empirically unsupported, set of weights described above.[3] Table 6.10 sets out the results of the Basic Model with the contribution of each scale modified by the appropriate attribute importance weights.

It was somewhat surprising and disappointing to find that this model did not perform nearly as well as the Primary Model where each attribute made an unweighted contribution to the total mode "scores". For Model II the mean value of rho was only 0.491 (compared with 0.566), the number of perfect

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1. As mode images were measured on a scale from 1.0 (most favourable) to 7.0 (least favourable) the weights had to be similarly arranged from 1.0 (very important) to 5.0 (very unimportant). A numerically small total "value" for a mode represents relatively high subjective utility associated with that mode.
2. If the selection of numerical weights was determined by the set that gave the best overall predictions then it would not be possible to argue that the model, as formulated, did or did not give an adequate representation of human decision processes.
3. Table A5.9 in Appendix 5d lists the results of a number of runs of the Basic Model to test alternative sets of numerical weights. Although the "standard" weights give one of the poorer overall levels of prediction the differences are not great.

TABLE 6.10 Basic Model (Model II): Results

Rho	Frequency	Percent
-1.00 to -0.81	2	0.8
-0.80 to -0.61	1	0.4
-0.60 to -0.41	3	1.2
-0.40 to -0.21	5	2.0
-0.20 to -0.01	17	7.0
0.00 to +0.19	23	9.4
+0.20 to +0.39	32	13.1
+0.40 to +0.59	25	10.2
+0.60 to +0.79	96	39.3
+0.80 to +0.99	37	15.2
1.00	3	1.2
Total	244	99.8

Mean Rho	0.491
Standard Deviation	0.500
Coefficient of Variability	101.8 percent

First Preferences By Predicted Rank

Rank Predicted	Frequency	Percent
1	100	41.0
1.5	1	0.4
2	70	28.7
2.5	0	-
3	26	10.7
3.5	1	0.4
4	20	8.2
4.5	0	-
5	14	5.7
5.5	1	0.4
6	11	4.5
Total	244	100.0

predictions was down to 3 from 7 and matches of first predictions with first preferences went from 112 to 100. A partial explanation of this unexpectedly poor result can be found in the need to delete the "Safety" and "Relaxation" attributes from the model because importance ratings were not obtained for them. Separate runs of the Primary Model resulted in a mean rho value of 0.538 when the "Relaxation" attribute was excluded and only 0.503 when both "Relaxation" and "Safety" were omitted. Even so the application of importance weights to the contribution of each attribute has had a negative impact on the "success" of Model II.[1] Why this should be so is not immediately clear but an examination of various "refined" models gives some insights into the complex interactions present within these data.

6.6 The Basic Model Refined

As well as allowing for individual variations in the valuing of specific mode attributes there are other refinements that can be introduced into the model. These are (a) varying the number of mode attributes that contribute to the decision (Choice Depth, Model III), (b) varying the choice context to allow for differences in the physical availability of certain modes (Model IV), (c) segmenting the study population to investigate differences between one group

1. Both R. Hudson (1972) and Clark and Cadwallader (1973) have reported that the subjective weighting of attributes contributed little or nothing to the explanatory power of their models. Hoffman (1958) and Shepard (1964) compared the weights obtained from multiple regression models of the decision process with subjective weights supplied by the same respondents. They concluded that respondents were not able to adequately assess the various roles of factors entering the decisions.

of respondents and another (Model V) and (d) allowing for a sequential decision making process such that less important attributes were used only if the more important ones did not identify one mode as sufficiently "better" than the others (Model VI). Each of these variants of the Basic Model will be considered in turn.

6.6.1 Choice Depth (Model III)

One of the most immediate questions that must be raised about the Basic Model concerns the incorporation of all nineteen available mode image attributes into the model. Does the average traveller consider this many aspects when he makes a mode choice decision? The available evidence suggests not. As part of the In-transit Survey respondents were asked to give 3 reasons to explain their choice of mode. Fifty-five respondents (11 percent of the study group) gave only one or two reasons. For these people, at least, the number of salient mode attributes needed to account for their decision was markedly less than the 19 included in the model. Furthermore, it can be noted that although only 3 reasons were requested, some respondents did supply more but in no case did the number of distinct mode choice reasons exceed eight.[1] It is highly unlikely that any person could take 19 different mode attributes into consideration. Miller (1956, p.91) suggested the notion of a "span of perceptual dimensionality" as the maximum number of dimensions that could be evaluated. He also added (1956, p.91) "I suspect

1. A maximum of 5 mode-choice reasons for each respondent was coded for the analyses reported in Chapter Four.

that ...... this span is somewhere in the neighbourhood of ten, but I must add at once that there is no objective evidence to support this suspicion." In the present study it is possible to make a very crude examination of this notion by varying the number of attributes input to the decision model and observing the changes in the output predictions. Immediately, however, a problem arises in that the particular variables excluded from the model to reduce the "dimensionality" of the problem, will certainly have widely varying effects on individual predictions: respondents were far from agreed on the importance attached to specific attributes. Two solutions to this problem are investigated. The first, reported in this section, is to define certain overall "orders of importance" for the attributes so that the "top 10" or "top 5" are common for all respondents. The second, described in Section 6.6.5, allows each respondent to define his own order of importance.

Three overall "orders of importance" are used here to define the variables to be excluded when the model is run with a varying number of attributes. Two of these originated in the In-transit Survey. Reasons Rank Order (RRO) was based simply on the frequency with which the mode-choice reasons were mentioned.[1] Descriptor Rank Order (DRO) was defined by the amalgamation of both mode-choice reasons and mode disadvantages.[1] Arithmetic means of the attribute importance ratings collected during the Mode Image Survey established the Overall Importance Order (OIO).[1] Table 6.11 presents the results of running the reduced model under these conditions.

Neither the Reasons Rank Order nor the Descriptor Rank Order provide any support for the suggestion that the decision makers used fewer than the full 19 mode attributes. In both cases the mean rho values are negative when only one attribute enters the model and they increase gradually, though with some fluctuations, as each additional attribute is added in.[2] The maximum mean rho values for both of these variants are reached only when all 19 attributes are included. Frequency of matches between first predictions and first preferences follows a similar pattern except that, for

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1. Reasons Rank Order: (From highest to lowest "importance") Cost, Travel Time, Flexibility, Convenience, Speed, Seating Comfort, Scenery, Timetabling, Spaciousness, Accessibility, Taking Luggage, Cleanliness, Crowding, Ventilation, Waiting, Social Status, Punctuality, Smooth Riding, Noise (See Section 4.1).
   Descriptor Rank Order: (From highest to lowest "importance") Cost, Travel Time, Flexibility, Convenience, Speed, Seating Comfort, Smooth Riding, Waiting, Ventilation, Accessibility, Cleanliness, Timetabling, Scenery, Spaciousness, Crowding, Taking Luggage, Noise, Punctuality, Social Status (See Section 4.3).
   Overall Importance Order: (from highest to lowest "importance") Timetabling, Cleanliness, Seating Comfort, Punctuality, Convenience, Smooth Riding, Waiting, Travel Time, Crowding, Flexibility, Taking Luggage, Speed, Accessibility, Cost, Spaciousness, Ventilation, Noise, Scenery, Social Status (See Section 6.4).

   Note that Safety and Relaxation have been excluded from these lists.

2. Note that these two rank orders produce identical results for the first six attributes.

TABLE 6.11 Choice Depth (Model III): Results

Number of Attributes Included in the Model	Reasons Rank Order			Descriptor Rank Order			Overall Importance Order		
	Rho[1]	Perfect[2]	Match[3]	Rho[1]	Perfect[2]	Match[3]	Rho[1]	Perfect[2]	Match[3]
1	-0.363	1	5	-0.363	1	5	0.157	1	31
2	-0.103	0	20	-0.103	0	20	0.370	1	76
3	-0.104	0	28	-0.104	0	28	0.507	2	97
4	0.025	0	53	0.025	0	53	0.477	1	111
5	0.106	1	58	0.106	1	58	0.489	3	109
6	0.264	2	73	0.264	2	73	0.556	6	111
7	0.201	1	78	0.357	2	87	0.511	5	104
8	0.193	1	79	0.337	2	85	0.519	6	108
9	0.250	2	87	0.378	1	90	0.499	4	104
10	0.253	3	88	0.378	1	94	0.413	2	102
11	0.339	4	92	0.409	3	98	0.461	4	103
12	0.391	1	95	0.386	2	97	0.477	4	106
13	0.388	2	95	0.358	2	92	0.467	2	100
14	0.415	4	94	0.384	2	98	0.414	3	91
15	0.380	1	93	0.369	1	94	0.429	4	95
16	0.450	2	99	0.428	3	101	0.456	4	99
17	0.437	3	96	0.467	3	102	0.486	5	102
18	0.471	2	99	0.459	5	100	0.459	5	100
19	0.491	3	100	0.491	3	100	0.491	3	100

1. Rho: Mean value of the rank order correlation coefficient.
2. Perfect: Number of perfect predictions.
3. Match: Number of times first prediction matched the first preference.

Descriptor Rank Order, results slightly better than the full basic model were obtained at the 16 and 17 attribute stages. The inability of the model reduced under Reasons Rank Order and Descriptor Rank Order to improve the predictive power of the Basic Model is not entirely surprising as only 33 of the respondents whose decisions are modelled here also contributed to the In-transit Survey that generated these two overall "orders of importance". Using the mode-choice reasons and mode disadvantages to define the order in which variables were added to the model has not shed much light on the question of how many attributes are used in the course of a mode-choice decision. Part of the reason for this must lie in the fact that two distinct groups of respondents were involved but there is also the possibility of some difference between the set of criteria used to explain the choice of mode for a specific real-life journey (In-transit Survey) and those that might affect a purely hypothetical decision (Mode Image Survey).

Use of the Overall Importance Order to define the sequence in which attributes are incorporated into the model does, however, provide some evidence for a limited "span of perceptual dimensionality". This arrangement generates a marked improvement in the predictive power of the model when compared with RRO and DRO. In only two cases each is the mean rho value and the number of matches exceeded by one or other of the alternative arrangements. All of these occur when a relatively large number of attributes have been included in the model and the OIO arrangement has lost much of its predictive power.

With only one attribute counting, the Overall Importance Order variant generates a mean rho value of just 0.157. Adding extra attributes one by one raises the mean rho to a local maximum at 3 attributes (ρ=0.507) that betters the full Basic Model and then further to the most powerful situation at six attributes (ρ=0.556). This stage also generates the highest number of perfect predictions (6) and greatest frequency of matches (111); though these latter figures are equalled at other stages. When more attributes are added to the model all 3 indices fluctuate and decline. Clearly, then, 6 attributes might be regarded as the optimum number of dimensions to enter into a mode-choice decision. Yet some ambiguity emerges, particularly when comparing the three indices used to evaluate the predictive ability of the model. The four attribute stage generates the same number of matches as the "optimum" 6 dimensions but obtains only one perfect fit and a relatively low mean rho. Conversely, stage eight equals the highest number of perfect predictions but has a lower number of matches and a lower mean rho than stage 6. It would therefore be unreasonable to make an unequivocal assertion about the "true" dimensionality of these mode-choice decisions. Nevertheless, it is certainly possible to conclude that the greatest overall predictive power of the model lies in a configuration that incorporates from 4 to 8 attributes; well under half the number included in the full Basic Model. Table 6.12A shows even further that the notion of a single "optimal" model is inappropriate. Attention is first directed toward the particular stage in the model at which each respondent first attained his "best

TABLE 6.12 Choice Depth: Overall Importance Order

A

Number of respondents that first gained their best fit or a match at the given stage

Stage	Best Fit	Match
	number of respondents	
1	27	31
2	10	49
3	50	29
4	18	23
5	19	4
6	38	4
7	12	2
8	13	7
9	8	3
10	3	5
11	10	1
12	7	-
13	4	1
14	5	-
15	-	1
16	2	-
17	6	3
18	6	1
19	6	-
No Match		80
TOTAL	244	244

B

Number of respondents with the stated number of best fits or matches

Number	Best Fits	Matches
	number of respondents	
1	130	12
2	35	11
3	19	8
4	18	9
5	14	3
6	9	4
7	2	4
8	4	7
9	2	7
10	4	9
11	-	3
12	4	8
13	1	3
14	-	4
15	1	5
16	1	15
17	-	12
18	-	24
19	-	16
No Match		80
TOTAL	244	244

fit" prediction, as identified by the largest rho value. How many variables have to be included in the model before an individual's preferences are most closely predicted? Later stages might equal or reduce this fit but not improve on it.

As many as 27 of the 244 respondents obtained their best fit using only the first attribute ("Timetabling" in this case) and a total of 162 respondents (or 66 percent) had achieved their best by the time 6 attributes were included. Stage 6 itself added fewer "best fits" than stage 3 and so looks even less like the optimum stage than ever. It is interesting to note that in very few cases was it necessary to use relatively large numbers of attributes to attain a first "best fit"; only 6 needed the whole set of 19.

Examination of the "best fit" rho values again shows that much of the predictive power of the model is lost by imposing a blanket structure on all respondents. The mean of all 244 "best fit" rho values was 0.722, markedly more than the 0.556 generated by stage 6. These "best fit" situations also generated 21 perfect predictions; stage 6 managed only six.

Matches between first prediction and first preference also reveal a rather complex situation. As many as 80 respondents (32.8 percent) did not gain a match at all within this model and this helps keep the rho values (which could, conceivably, average over 0.850 without ever achieving a correct mode-choice decision) in some perspective. Nevertheless, first matches show a similar concentration on the early stages of the model: 57 percent of the respondents had achieved a match by stage 6. Very few respondents needed more than 10 stages before the model generated a match between the first prediction and their first preference.

In another important respect, however, the two indices diverge quite sharply. The internal stability of this model can be gauged by examining all 19 predictions made for each respondent. If most of these predictions give the same result then the model can be regarded as quite stable; if they are all different a high degree of instability is present. Here the question of model stability is examined by counting (a) the number of times each respondent achieved his best fit and (b) the number of matches obtained over the full 19 stages. This analysis is summarised in Table 6.12B and it can be seen that more than half of the respondents obtained their best fit once and only once. Most of the remainder exhibit only a very limited degree of stability although one person did gain the same best fit sixteen times.

When stability is measured in terms of the number of matches, the picture is very different. Twenty-seven percent gained more than 15 matches and 16 persons achieved a match at every one of the 19 stages.[1] In only 12 cases (4.9 percent) did the 19 stages generate a single match. However, the apparent stability of the matches index must be put alongside the fact that 80 persons did not achieve any matches at all with this model.

Although this section has provided some evidence for the notion of a "limited span of perceptual dimensionality" and has hinted that 4 to 8 dimensions might be most appropriate

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1. Of the 4636 separate predictions made (244 respondents times 19 stages), 1849 or 39.9 percent achieved matches.

for mode-choice decisions the overall impression must be one of considerable complexity. No single structure emerges as an obvious pattern to be adopted in future decision models. To some extent this lack of structure might be explained by the problem of imposing a common order of attribute importance. Further refinements of the model seek to improve its predictive ability and to move back toward wholly individual decision processes.

6.6.2 Choice Context (Model IV)

Chapter Three investigated the various cognitions of the choice context reported by respondents to the In-transit Survey. The discussion there pointed out that less than half of the study population (45 percent) recognised the availability of all six "inter-city" modes of travel. Only 7 percent viewed all six modes as practicable alternatives. For many people, then, certain modes just do not enter the mode-choice decision process. In the choice model these would be spurious alternatives. Data on the cognised choice context were not collected during the Mode Image Survey but the possibility that fewer than six modes might be considered can be examined indirectly. Two situations are discussed. The first covers five modes excluding only motorcycle and is suggested by the choice context data reported in Chapter Three. Of the six inter-city modes motorcycle was clearly the mode least likely to be included in either the possible-mode or practicable-mode sets.[1] The second situation

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1. Only 12 percent of the respondents viewed motorcycle as a practicable mode for inter-city travel.

examined directs attention to the "public" modes of transport, excluding both of the "private" modes, car and motorcycle. Not everyone owns or has access to one or other of these private modes and so a decision process that included them would be largely hypothetical.[1] Results for Model IV run with a reduced choice context are given in Table 6.13.

Excluding motorcycle from the choice context does result in a slight improvement in the performance of the model. There are now 11 cases of perfect prediction and the mean value of rho reaches 0.522. However the number of cases where the first prediction matched the first preference increased by only one to 101. Although motorcycle would presumably be a spurious alternative for many of the people studied, excluding it from the choice context had such little overall effect on the "success" of the model largely because motorcycle was the least preferred of the six modes. Nearly 70 percent of the respondents rated motorcycle sixth and last (Table 6.1). Removing motorcycle from the model would have no effect on the predictions made for these people: the relative positions of the other modes would remain unchanged.

Much more interesting results are obtained when both motorcycle and car are removed from the model leaving just the four "public transport modes". With 49 perfect predictions and 10 "perfectly wrong" predictions this model seems to have had a polarising effect on the study population. For some people this model is highly appropriate yet for an almost equal number the predicted ranks have virtually no

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1. This point is also examined in Section 6.6.3.

TABLE 6.13 Choice Context (Model IV): Results

Rho	5 Modes[a] Frequency	5 Modes[a] Percent	4 Modes[b] Frequency	4 Modes[b] Percent
-1.00 to -0.81	3	1.2	10	4.1
-0.80 to -0.61	3	1.2	3	1.2
-0.60 to -0.40	2	0.8	0	-
-0.40 to -0.21	6	2.5	25	10.2
-0.20 to -0.01	10	4.1	15	6.1
0.00 to +0.19	23	9.4	30	12.3
+0.20 to +0.39	36	14.8	39	16.0
+0.40 to +0.59	17	7.0	0	-
+0.60 to +0.79	60	24.6	9	3.7
+0.80 to +0.99	73	29.9	64	26.2
+1.00	11	4.5	49	20.1
Total	244	100.0	244	99.9

	5 Modes	4 Modes
Mean Rho	0.522	0.417
Standard Deviation	0.500	0.493
Coefficient of Variability (percent)	95.8	118.2

First Preferences By Predicted Rank

Predicted Rank	Frequency	Percent	Frequency	Percent
1	101	41.4	114	46.7
1.5	1	0.4	2	0.8
2	72	29.5	72	29.5
2.5	1	0.4	0	-
3	35	14.3	36	14.8
3.5	0	-	1	0.4
4	21	8.6	19	7.8
4.5	1	0.4	0	-
5	12	4.9	0	-
5.5	0	-	0	-
6	0	-	0	-
Total	244	100.1	244	100.0

a. 5 Modes - Aeroplane, Bus, Car, Taxi, Train (excluding Motorcycle)

b. 4 Modes - Aeroplane, Bus, Taxi, Train (public transport modes only) relationship with the preference ranks or are completely inverted. One possible explanation of this situation lies in the distinction between "car owners" and "non-owners". It could be that "car owners" are so used to the immediate availability of their own vehicle that their cognitions of attribute importance are strongly biassed toward the favourable characteristics of a car. Consequently, when car was removed from the choice context, the computed predictions for the remaining modes could deviate markedly from stated preferences. A similar argument applied to "non-owners" might well serve to improve discrimination amongst the public modes when the deviant case of car (depending for its attraction on quite different attributes) was excluded. Clearly, there is a strong case for the application of a market segmentation model to further examine the implications of this result.

6.6.3 Market Segmentation (Model V)

One of the most important themes underlying this study has been an examination of the notion that similar people behave in similar ways for similar reasons. While the broader aspects of the relationship between the characteristics of the individual and the ability of the choice model to predict his mode preferences are deferred until Section 6.7, attention is now directed to an examination of two important segmentations of the study population.

An earlier section of this chapter has commented on the marked differences between the mode preference rankings reported by respondents who received the "business trip" version of the questionnaire and the rankings generated by the "holiday trip" version. Notable differences between the two trip purposes were also noted during the discussion of the attribute importance ratings. It therefore seemed possible that some distinction might be drawn between the decision processes that operated for "business trips" and for "holiday trips". Consequently the model was run separately for each of these two trip purposes, with attribute order defined for each by their mean importance ratings. The results are presented in Table 6.14.[1]

Superficial examination of the results obtained from the full 19 attribute model could lead to the suggestion that business trip decisions, with a higher mean rho value, were "more rational" (more easily predicted by a numerical model) than the relatively "idiosyncratic" holiday trip decisions. Appealing though this conclusion might be, it is clearly a gross simplification. Using the full 19 attribute model negates any effect that might be gained from attribute order and so these results merely represent the subdivision of respondents into 2 groups. In fact a t-test indicated that the difference between the two mean rho values was not statistically significant at the 0.10 level.

1. The attribute orders used were:
Business Trips (from highest to lowest "importance")
Timetabling, Punctuality, Waiting, Travel Time, Convenience, Smooth Riding, Seating Comfort, Cleanliness, Speed, Crowding, Flesibility, Accessibility, Ventilation, Taking Luggage, Spaciousness, Cost, Noise, Social Status, Scenery.
Holiday Trips (from highest to lowest "importance")
Cleanliness, Seating Comfort, Smooth Riding, Convenience, Crowding, Timetabling, Taking Luggage, Flexibility, Cost, Punctuality, Waiting, Spaciousness, Travel Time, Accessibility, Ventilation, Noise, Speed, Scenery, Social Status.

TABLE 6.14 Market Segmentation (Model V): Trip Type

	Business Trips	Holiday Trips
Number of Cases	121	123
Full Model (19 Attributes)		
Mean Rho	0.536	0.446
Perfect Predictions (percent)	1.7	0.8
Matches (percent)	28.9	52.8
Reduced Model[a]		
(i) Best Stage	9	7
Mean Rho	0.603	0.516
Perfect Predictions (percent)	3.3	1.6
Matches (percent)	44.6	52.0
(ii) Best Fits		
Mean Rho	0.723	0.700
Perfect Predictions	8.2	11.4
Matches (percent)	48.8	62.6

a. In each case the order in which attributes were incorporated into the model was determined by the mean attribute importance ratings.

A more realistic view of the segmented model is obtained by monitoring the model output as each new attribute is added into the model. For business trips the mean rho value increased steadily until it reached a maximum of 0.603 at stage 9. The addition of extra attributes after this stage generated quite marked fluctuations in the mean rho value until it finished at 0.536 for the full 19 attributes. It is perhaps surprising to find that business trips reveal an apparent "perceptual dimensionality" as high as 9 but the attributes involved do include all those that would be expected to matter to businessmen: "Timetabling", "Punctuality", "Waiting", "Travel Time", "Convenience", "Smooth Riding", "Seating Comfort", "Cleanliness" and "Speed". The results for holiday trips reached a maximum value of rho = 0.516 at stage 7 but over the full attribute list reveal a quite different structure. Whereas the mean rho for the business trip sample rose steadily to a maximum at stage 9 and then declined with fluctuations, the same index for holiday trips started relatively high (0.439 compared with 0.125) and varied remarkably little over the full range of attributes. This result suggests that the effect of individual attributes in the model is much more diffuse for holiday trips with a balancing of better and poorer individual fits as extra attributes were added. In contrast the net effect of each of the first 9 attributes in the business model is to steadily strengthen overall predictive power. The labels "idiosyncratic" and "rational" for holiday and business oriented decisions might seem appropriate after all.

Although the best stage mean rho for holiday trips is noticeably lower than the business trips equivalent, the diffuse effect of single attributes in the holiday model (as noted above) might well mask improved predictions for individual respondents. An analysis of the best fit obtained for each respondent over the full 19 stages shows that this is indeed the case. Averages of the best fit rho values indicate very little difference between the business segmentation (ρ=0.723) and the holiday group (ρ=0.700). Furthermore, it is interesting to note that a much higher proportion of the holiday group obtained matches between first predictions and first preferences. Reasons to explain this apparent discrepancy between the similar best fit rho values but divergent rate of matches can be found in the actual mode preferences of the two groups and some degree of structural bias in the model. Respondents to the business trip questionnaire concentrated strongly on aeroplane as first preference mode (84 of the 121 persons) yet only 44 percent of that 84 were correctly predicted. Another 26 of this same group specified car as their first preference and the model predicted 21 of these (81 percent) in first place. On the other hand, the preferences of the holiday trip respondents concentrated on car and 72 percent of these were correctly predicted. Further evidence for this structural bias toward car can be found in the stage by stage progression of even the unsegmented model. Car was predicted first in 63.6 percent of all occasions: it formed only 35.7 of all first preferences. This structural bias toward car could arise from the use of an excessive number of attributes favourable toward car (e.g. "Flexibility", "Accessibility", "Punctuality", "Waiting", "Taking Luggage", etc.). As well as this effect, it would seem likely that a good number of the responses giving first preference to air (51.2 percent of all respondents) were the product more of wishful thinking than a realistic choice. The two factors clearly operate in concert: the first making it easier to predict car, the second minimising the chances of establishing a rational connection between images and preferences. Despite this problem of structural bias the first Market Segmentation Model has certainly improved the predictive power of the model and provided further insights into its operations.

The second type of market segmentation has already been highlighted in Section 6.6.2 during the discussion of choice context. Persons who do not own nor have the regular use of a motor vehicle are clearly more constrained in their mode-choice than people who do have access to a car or a motorcycle. Two submodels were run to examine this aspect of market segmentation. One compared car owners and non-owners in the context of all six inter-city modes while the other restricted attention solely to the four modes of public transport.

Intuitively, one would expect that car owners, with their clearer knowledge of car's advantages and limitations, would achieve better predictions than non-owners in the six mode context. With that advantage removed (and less experience of public modes) owners would perhaps fare more poorly in the context of public modes. In fact the results presented in Table 6.15 do not support this suggestion.

Owners were better predicted on all three measures in

TABLE 6.15 Market Segmentation (Model V): Car Ownership

	Six Modes[a]		Four Modes[b]	
	Own Car[c]	Not Own[c]	Own Car[c]	Not Own[c]
Number of Cases	102	142	102	142
Full Model (19 Attributes)				
Mean Rho	0.527	0.465	0.456	0.389
Perfect Predictions (percent)	2.0	0.7	23.5	25.0
Matches (percent)	45.1	38.0	51.0	43.6
Reduced Model[d]				
(i) Best Stage	8	5	9	8
Mean Rho	0.549	0.522	0.496	0.428
Perfect Predictions (percent)	2.0	2.1	21.6	28.2
Matches (percent)	46.1	43.0	60.8	56.3
(ii) Best Fits				
Mean Rho	0.704	0.714	0.736	0.714
Perfect Predictions (percent)	4.9	9.9	38.2	42.3
Matches (percent)	55.9	56.3	72.5	64.1

a. Six Modes (all inter-city modes) Aeroplane, Bus, Car, Motorcycle, Taxi, Train.
b. Four Modes (public transport modes only) Aeroplane, Bus, Taxi, Train.
c. Defined by the question "do you own, or have regular use of, a motor car?"
d. In each case the order in which attributes were incorporated into the model was determined by the mean attribute importance ratings:

Own Car (from highest to lowest "importance") Timetabling, Waiting, Cleanliness, Convenience, Seating Comfort, Punctuality, Travel Time, Smooth Riding, Crowding, Flexibility, Ventilation, Accessibility, Spaciousness, Cost, Taking Luggage, Speed, Noise, Scenery, Social Status.
Not Own Car (from highest to lowest "importance") Timetabling, Smooth Riding, Punctuality, Seating Comfort, Cleanliness, Convenience, Travel Time, Waiting, Crowding, Speed, Flexibility, Taking Luggage, Accessibility, Cost, Spaciousness, Ventilation, Noise, Scenery, Social Status.

the full model for six modes but the gap between them and Non-owners was narrowed and reversed in the reduced model. When individual "best fits" were examined non-owners did better than owners on all indices and especially for perfect predictions.

The four-mode context also reversed a priori expectations. In most cases car-owners were better predicted than non-owners. Perfect predictions were the only exception to this pattern though they were only marginally more frequent among non-owners.[1] One possible explanation for this reversal of anticipated findings might be found in "irrational" images of car (over-optimistic or super-critical) held by owners that reduced predictability in the six-mode context below the expected level. With this "irrational" element removed from the 4-mode context, owners' perceptions of public transport modes were sufficiently clear to generate consistently better predictions than non-owners.

Only two main market segmentation variants of the Basic Model have been discussed here. They have demonstrated, yet again, that logical extensions do help increase the predictive power of the model. Furthermore it is clear that the model is most effective when considerably fewer than the full 19 attributes are included. Five of the six Market segmentation submodels attained their "best stage" with seven to nine attributes: the non-owners/six-modes version required only

1. The frequency of perfect predictions was very much higher here than for any other model analysed. It should be recalled that 6 modes generate 720 possible rank order patterns compared with only 24 for the 4 mode context. The probability of obtaining a perfect prediction by chance alone is therefore very much higher in the 4 mode case.

five. Yet it is obvious from the mean rho values that even best stages fall far short of the individual predictions indexed by best fits. Much of the shortfall can be found in the need to impose a single overall attribute order on all respondents in a particular market segment. Section 6.6.4 attempts to combine the desirability of using purely individual orders of attribute importance with the obvious advantages of a reduced model containing fewer than the full 19 attributes.

6.6.4 Sequential Decision Making (Model VI)

Section 6.6.1 reported one attempt to investigate the question of how many attributes enter into a mode-choice decision. The model discussed there had a major drawback in that it was necessary to define overall orders of importance for the attributes so that the 5, 10 or 15 "best" attributes could be entered into the model at any one trial. This section moves back toward the ideal of modelling wholly individual decisions by using the reported attribute importance ratings to define a five step decision sequence that starts by using only the most significant attributes and then at each step adding in clusters of less important attributes until the fifth and final step when all 19 are included in the model. The rationale behind this sequential procedure can be found in an intuitive interpretation of an everyday decision situation. If the most important criteria do not sufficiently distinguish two alternatives then the decision-maker will consider progressively less important criteria until one of the alternatives is significantly "better" than the other.[1] In this study the steps in the decision sequence for any given respondent are defined by grouping all attributes rated as <u>very important</u> into the cluster of most important criteria. Those rated <u>quite important</u> make up the second cluster and so on to the group seen as <u>very unimportant</u> which defines the cluster of least significant attributes. In following this procedure, however, considerable detail is lost. As there is no way of establishing an order of precedence for attributes within a particular cluster, the sequential aspect of this model is reduced from the 19 steps available in Model III to a maximum of 5 steps; one for each level of importance rating. It also directs attention away from the question of the most effective number of attributes in the model (dimensionality of the decision) and focusses it on the optimal level in the hierarchy of importance ratings. The number of attributes given a particular importance rating by any one respondent was independent of the position of that rating in the hierarchy: one respondent rated all 19 attributes as "very important" while 8 respondents did not use that rating at all. Results from the Sequential Model refer only to the levels of the importance ratings: they cannot help identify the number of attributes that enter into a decision.

The Sequential Model calculated total mode "scores" (and hence established the predicted rank order) for each respondent using the cluster of most significant attributes and then repeated the procedure for four additional stages; at

1. Fox (1965) used this approach in his "step" model of the route-choice decision and a similar procedure was suggested by Lee (1971).

each stage adding in the next most important cluster of attributes. At the fifth and final stage of this sequence all 19 attributes were included thus duplicating the Basic Model reported above. Table 6.16 sets out the summary results for each of these stages and also summarises the "best fit" achieved for each respondent. Equivalent results from the Basic Model are included for comparison.

It is apparent that introducing this sequential component does affect the model's ability to reproduce the preference rankings. Stage 1 was markedly below the other stages in terms of both the mean value of rho and the number of matches between first prediction and first preference. Stage 2 achieved the highest number of matches while Stage 3 generated the largest mean rho thus repeating the divergence between these two methods of evaluating the model that was mentioned above. But neither of these two stages came near the "best fit" situation which achieved a mean rho of 0.649 and 123 matches. Within the "best fits", however, Stage 2 with a mean rho of 0.675 and a very high 66.3 percent of matches would seem to define the optimal stage in the decision sequence. Yet even here there is good evidence of the futility of trying to develop a single rigid model to predict these mode-choice decisions as only 32.8 percent of the respondents gained their "best fit" at Stage 2. Furthermore, Stage 5, which is superior only to Stage 1 in the overall analysis and generates only 11 "best fits", does achieve an exceptionally high mean rho for these best fits.

TABLE 6.16 Sequential Decision Making (Model VI): Results

	Decision Stage[a] 1	2	3	4	5	Best Fit	Basic Model
Decisions Modelled	235[b]	244	244	244	244	244	244
Mean value of rho	0.373	0.514	0.524	0.504	0.491	0.649	0.491
Number of Perfect Predictions	0	3	2	2	3	6	3
Number of matches: First Prediction and First Preference	83	111	101	104	100	123	100
Matches as a percentage of the number of decisions modelled	35.3	45.5	41.4	42.6	41.0	50.4	41.0
Best Fits							
Number	70	86	50	27	11	244	-
Mean value of rho	0.606	0.675	0.632	0.663	0.768	0.649	-
Number of matches First Prediction and First Preference	33	57	18	11	4	123	-
Matches as a percentage of the number of "best fits"	47.1	66.3	36.0	40.7	36.4	50.4	-

a. The decision stages are arranged in sequence from
1 - the cluster of attributes rated "very important"
and 2 - the cluster of attributes rated "very important" or "quite important"
to 5 - all attributes

b. Eight respondents did not use the attribute importance rating "very important" and so they do not appear at Stage 1. Another person used only one importance rating at the "very important" level but also omitted to give any valid mode-image responses for that particular attribute. Thus only 235 respondents had decisions modelled at decision stage 1.

6.6.5 The Refined Decision Models: An Overview

Four major refinements of the Basic Model have been described and the results obtained from them briefly discussed. In each case the interactions among the various aspects of a particular sub-model have proved complex and have not always matched seemingly reasonable a priori expectations. Nevertheless a rational connection between mode images (as defined in this study) and mode preferences has been demonstrated. This section seeks to put the results obtained from the various decision models into some perspective before the analysis moves to a slightly different theme in Section 6.7.

Table 6.17 summarizes the results obtained from the models discussed above and reveals some marked variations in all three indices used to evaluate them. The mean rho value, for example, ranges from 0.389 up to 0.736: one model attained only 28.9 percent matches while another reached 72.5 percent. Perfect predictions varied from 1.2 percent to 42.3 percent. Despite these fluctuations, however, it is possible to present some generalisations that help provide a little insight into the complex interactions within the models.

1) In general the full models employing all 19 attributes match the level of predictability set by the Basic Model. Reduced models, with attribute order determined by the means of the attribute importance ratings, reveal notably improved predictive power with fewer than half of the full number of available attributes.

2) The few Market Segmentation Models tested effected small

TABLE 6.17 Decision Models: Summary Results

Model	Model Type	Model Conditions		Number of Respondents	Mean Rho Value	Perfect Predictions (percent)	Matches (percent)
I	Primary			244	0.566	2.9	45.9
II	Basic			244	0.491	1.2	41.0
III	Choice Depth	Overall Importance Order	: Best Stage	244	0.556	2.5	45.4
III		Overall Importance Order	: Best Fits	244	0.722	8.6	53.3
IV	Choice Context	5 Modes		244	0.522	4.5	41.4
IV		4 Modes		244	0.417	20.1	46.7
V	Market Segmentation	Business Trips	: Full Model	121	0.536	1.7	28.9
			: Best Stage	121	0.603	3.3	44.6
			: Best Fits	121	0.723	8.2	48.8
		Holiday Trips	: Full Model	123	0.446	0.8	52.8
			: Best Stage	123	0.516	1.6	52.0
			: Best Fits	123	0.700	11.4	62.6
		Own Car (6 Modes)	: Full Model	102	0.527	2.0	45.1
			Best Stage	102	0.549	2.0	46.1
			Best Fits	102	0.704	4.9	55.9
		Not Own (6 Modes)	: Full Model	142	0.465	0.7	38.0
			Best Stage	142	0.522	2.1	43.0
			Best Fits	142	0.714	9.9	56.3
		Own Car (4 Modes)	: Full Model	102	0.456	23.5	51.0
			Best Stage	102	0.496	21.6	60.8
			Best Fits	102	0.736	38.2	72.5
		Not Own (4 Modes)	: Full Model	142	0.389	17.6	43.6
			Best Stage	142	0.428	28.2	56.3
			Best Fits	142	0.714	42.3	64.1
VI	Sequential Decision Making		Best Fits	244	0.649	2.5	50.4

improvements in predictability for the mean rho and matches measures and some relatively spectacular results for perfect predictions. Interpretation of the differences between segments proved very difficult.

3) Limiting the choice context to the four public transport modes produced relatively high proportions of perfect predictions and matches but, if anything, reduced the mean rho values.

4) In every case "best fits" represented a very marked improvement over the "full model" or "best stage" situations and showed that a great deal of the predictive ability of a particular model was lost when a set framework was applied to all decisions.

5) Despite the variety of submodels that were tried it is still surprising to find that the mean rho value obtained from the (unweighted) Primary Model was exceeded by only one of the standard framework models (Business Trips : Best Stage).

On this evidence, the use of importance ratings to weight the contribution of individual attributes seems to have confused the operation of the model. Yet, when matches between first preferences and first predictions are considered, the use of attribute weights does appear to have effected marginal improvements.

It would be possible to further refine and combine these models in attempts to increase overall predictive power and to clarify the effect of attribute weighting. Clearly, however, the number of models requiring examination could become very large and "success" would depend on striking the right combination by chance. Section 6.7 takes an alternative step in the same direction by attempting to uncover some of the factors that might help explain why individual decisions were closely or poorly predicted by the model.

6.7 Sources of Variation in the Accuracy of the Modelled Choices

Earlier sections of this chapter have discussed a simple numerical model (and several logical refinements of it) for predicting mode-choice decisions. The various models achieved moderate but not outstanding success in reproducing the reported mode preference rankings. While the ranking patterns of some respondents were predicted perfectly (or within one rank position) for others the fit was poor. If it is argued that the family of models presented has some degree of structural validity then one explanation for person to person variations in the accuracy of model predictions could lie in the characteristics of the respondents themselves. Intuitively, one would expect psychological and personality variables to be important here, especially as the model presumes a rational weighing up of the various possibilities. No information was collected on these types of variables, however, and so alternative explanations have to be sought in standard socio-economic measures. Low income, for example, might encourage a more careful decision: systematic biases for or against particular modes might conceivably be related to sex, occupation or travel experience. A second general source of variation in the accuracy of model predictions might be found in the configurations of the individual inputs to the decision model. Particular patterns of response to the mode image, attribute importance or mode preference questions could, perhaps, have biassed the output from the model.[1] The objective of this section, then, is to examine the results from selected models to see if any systematic relationship exists between the accuracy with which any one respondent's preferences were predicted and the personal characteristics or mode image response pattern of that respondent.

Although it was designed for much larger problems than the one attempted here, Automatic Interaction Detector (AID) is an ideal tool for the task at hand. AID "employs a nonsymmetrical branching process, based on variance analysis techniques, to subdivide the sample into a series of sub-groups which maximize one's ability to predict values of the dependent variable."[2] In the present case the dependent variable is the rho value that measures the fit between predicted and preferred mode rank orders. The AID algorithm searches the predictors input to the problem to find that predictor, and the division of categories within that predictor, which defines the two sub-groups of observations accounting for the largest possible proportion of the variance in the dependent variable. Starting with the sub-group that has the largest within group sum of squares, this procedure is repeated using each derived sub-group of observations until no further splits of the existing sub-groups are possible. A subgroup can be split if (a) each of the derived groupings

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1. Note, of course, that these response patterns might also be related to the personal characteristics of the respondent.
2. OSIRIS Manual: Instructions for the use of AID (p.301). See Sonquist and Morgan (1964) for further detail on the AID algorithm.

contains more than a predetermined number of observations (b) the split accounts for more than a predetermined proportion of the total variance in the dependent variable and (c) the total number of unsplit subgroups does not exceed a predetermined figure.[1] AID is particularly suitable for the analysis required here because it needs a continuous or interval dependent variable (rho value), permits the use of nominal and ordinal predictors (such as age, sex, occupation and community) and it does not require the assumptions of linearity and additivity found in regression models.[2]

Four decision models were selected for analysis by AID: the Primary Model (Model I); the Basic Model (Model II, with the contribution of individual attributes to the total mode score modified by the attribute importance ratings); the Sequential Model (Model V, the best fit rho value) and the Choice Depth Model (Model III, the mean of the 19 rho values computed for each respondent).[3] The analyses searched 39 predictor variables for the two-way split in the observations present in a particular group that accounted for the highest proportion of the within group variance.[4] These predictor variables and the categories into which each was subdivided

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1. For all of the applications of AID reported here these parameters were set as follows:
   (a) minimum group size = 10 observations
   (b) split reducibility criterion = 0.5 percent
   (c) maximum number of groups = 20
2. Hartgen (1972) used AID to examine the sources of bias in attitudes to modes of transport.
3. Market segmentation models were not considered because they would have reduced even further the small (in AID terms) number of observations available for analysis.
4. As the attribute importance ratings were not used in the Primary Model the six "Weight" variables were removed from the AID analysis of that model.

are presented in Table 6.18. A conceptual problem was raised by the existence of a number of "Not Stated" responses to the Personal Characteristics and Travel Experience Variables. As there was no strong rationale to deal with them in any other way they were left as separate "zero" categories. The number of "Not Stated" responses was relatively small and so it is felt that they did not have any noticeable effect on the overall analysis.

6.7.1 AID Analysis: Rho values

The first subdivision in the analysis of rho values from the Primary Model was made on the Preference : Air variable and generated groups containing 71 and 29 percent of the study group respectively (Table 6.19 and Figure 6.1).[1] The larger group consisted of respondents who had given Air as their first, second or third preference mode and it revealed an overall level of "predictability" (mean rho value) markedly higher than that for all 244 respondents. Removal of a small subgroup (Preference : Taxi equals 5 or 6) had only a minor effect on the mean prediction for the group but a split on Occupation at the 4th stage left 27 percent of the respondents with a mean rho of 0.772, the highest value for any subgroup in this analysis. At the other end of the scale, the respondents who put Air low in their preference order and also reported little experience of car (under 6 trips) were very poorly predicted indeed (mean rho = 0.000).

1. Given the small number of observations involved later steps in the AID analyses could be unreliable and so only the first six steps are presented.

TABLE 6.18 AID Analysis: Predictors

Predictor	Categories
Personal Characteristics	
Age	(in years) 0-19, 20-29, 30-39, 40-49, 50-59, 60+
Sex	male, female, Not Stated
Occupation	Professional, Managerial, Clerical, Sales, Service, Agriculture, Production Worker, Not Economically Employed, Not Stated.
Place of "Employment"	School, University, Government, Other
Community	Malay, Chinese, Indian, Other, Not Stated
Income	(Malaysian dollars per month) 0-150, 151-300, 301-500, 501-750, 751-1000, 1001-1500, 1501+, Not Stated
Car Ownership	Own, Do not own
Motorcycle Ownership	Own, Do not own
Mode Preference Variables	
Preference : Air	Rank Order 1, 2, 3, 4, 5, 6
Preference : Bus	"
Preference : Car	"
Preference : Motorcycle	"
Preference : Taxi	"
Preference : Train	"
Travel Experience Variables	
Experience : Air	(Trips) None, 1-2, 3-5, 6-10, 11-20, 20-50, Over 50, Not Stated
Experience : Bus	"
Experience : Car	"
Experience : Motorcycle	"
Experience : Taxi	"
Experience : Train	"
Experience : Total	"
(Note that travel experience was defined as the number of trips between towns)	
Survey Response Variables	
Questionnaire Language	Malay, English
Trip Type	Business, Holiday
Trip Destination	Penang, Singapore, Kuala Lumpur
Weight 0	Number of Attribute Importance Ratings: Not Stated
Weight 1	" : Very Important
Weight 2	" : Quite Important
Weight 3	" : Neither Important nor Unimportant
Weight 4	" : Quite Unimportant
Weight 5	" : Very Unimportant
Rating 0	Number of Mode Image Ratings: Not Stated
Rating 1	" : Very favourable
Rating 2	" : Quite favourable
Rating 3	" : Slightly favourable
Rating 4	" : Halfway between
Rating 5	" : Slightly unfavourable
Rating 6	" : Quite unfavourable

(contd)

TABLE 6.18/contd.

Rating 7	"	: Very unfavourable
Rating 8	"	: Irrelevant scale

(Note that the number of mode image ratings in each category was summed for each respondent over all six modes and then divided by 6.0 to give a mean distribution of ratings per mode)

TABLE 6.19 AID Analysis: Primary Model (Model I): Rho Values

Stage[a]	Parent Group	Split on Predictor	Creates Groups	Categories	Number in Group	Mean Rho	Standard Deviation
	A				244	0.566	0.342
1	A	Preference : Air	B	1-3	174	0.693	0.225
			C	4-6	70	0.251	0.378
2	C	Experience : Car	D	6 trips and Over	40	0.439	0.232
			E	Under 6 trips, Not Stated	30	0.000	0.390
3	B	Preference : Taxi	F	1-4	152	0.714	0.205
			G	5-6	22	0.542	0.288
4	F	Occupation	H	Managerial, Sales, Agriculture, Not Economically Employed, Not Stated	66	0.772	0.167
			I	Professional, Clerical, Services, Production Work	86	0.671	0.219
5	E	Preference : Car	J	1	16	0.240	0.223
			K	2-6	14	-0.276	0.357
6	I	Experience : Car	L	Under 3 trips, Not Stated	28	0.751	0.165
			M	3 trips and Over	58	0.632	0.232

a. Only the first six stages are reported here.

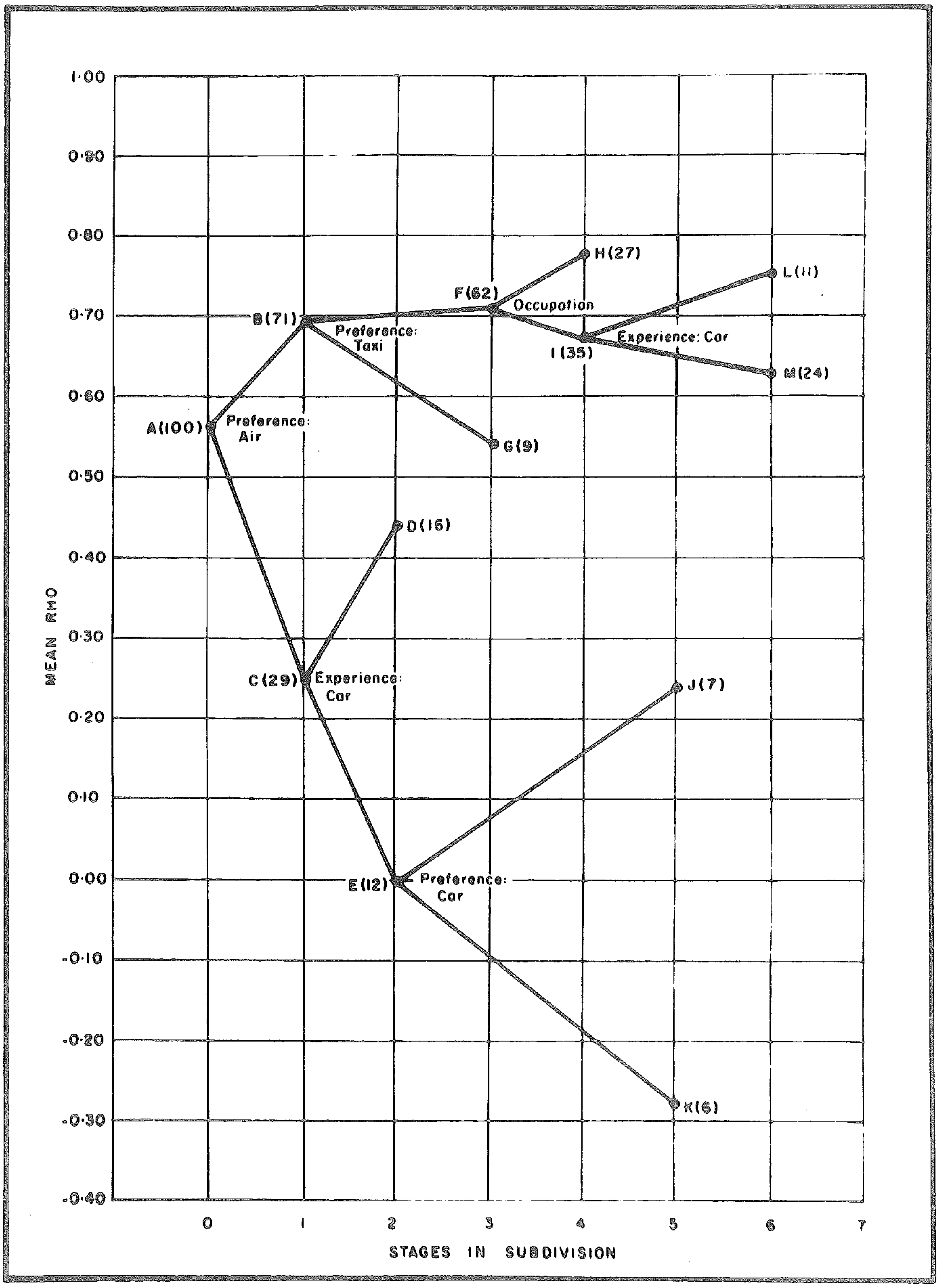

Figure 6.1 AID Analysis: Rho Values

Subgroups obtained at each stage of the subdivision are identified as in Table 6.19. Numbers in parentheses indicate the proportion of the total number of observations that is contained within each subgroup.

That subgroup contained 12 percent of the respondents and splitting it again on Preference : Car left those who did not accord Car first preference with a mean rho of -0.276. On the average, then, the rank orders predicted for this cluster were negatively related to the reported preference orders.

It is clear that the Preference : Air variable defines two groups of respondents that differed markedly in the success with which mode preference rankings were predicted by the Primary Model. The preferences reported by persons who ranked Air 1, 2 or 3 were fairly well predicted: the Primary Model seemed much less appropriate for those who put Air lower in the preference order.

AID analyses of the Basic and Sequential Models reveal results similar to those obtained for the Primary Model (Table 6.20). The first split is made on the same predictor (and identical categories) in each case. Details of succeeding splits vary but all have Preference : Taxi at stage 2 or stage 3 and the similarities in the types of variables involved are evident. It would appear that the same general factors affect the predictive power of all three models.

Analysis of the Choice Depth Model was conceptually distinct in that it assessed the stability of a series of sub-models (using from 1 to 19 attributes) rather than the gross predictive power of any one model. Yet, again, Preference : Air is the predictor that defines the first subdivision. Persons who gave Air the preference ranks 1, 2 or 3 revealed a markedly higher mean rho over the 19 sub-models than those who accorded air a lower preference ranking. Later splits differ somewhat from the first three models but again the

TABLE 6.20 AID Analysis : Summary Results

		Model			
		Primary[a]	Basic	Sequential	Choice Depth
			Split on Predictor		
Mean Rho[b]					
Subdivision Stage	1	Preference : Air	Preference : Air	Preference : Air	Preference : Air
	2	Experience : Car	Preference : Taxi	Preference : Car	Preference : Bus
	3	Preference : Taxi	Experience : Car	Preference : Taxi	Experience : Car
	4	Occupation	Preference : Car	Place of Employment	Occupation
	5	Preference : Car	Occupation	Experience : Taxi	Preference : Bus
	6	Experience : Car	Preference : Train	Experience : Total	Preference : Train
Matches[c]					
Subdivision Stage	1	Preference : Car	Preference : Car	Preference : Car	Preference : Car
	2	Preference : Air	Preference : Air	Preference : Air	Place of Employment
	3	Age	Age	Rating 1	Age
	4	Rating 1	Preference : Taxi	Income	Preference : Air
	5	Income	Weight 4	Weight 1	Rating 1
	6	Experience : Taxi	Occupation	Experience : Taxi	Preference : Train

a. Note that the 5 "Number of Weights" predictors did not enter the analysis for the Primary Model.

b. The dependent variables for the AID analysis were
   (i) Primary and Basic Models : the rho value as calculated
   (ii) Sequential Model : the best fit rho value
   (iii) Choice Depth Model : the mean of the 19 rho values calculated for each respondent

c. The dependent variables for the AID analysis were
   (i) Primary and Basic Models : the rank predicted for the first preference mode
   (ii) Sequential Model : the rank predicted for the first preference mode (at the stage defined by the best fit rho value)
   (iii) Choice Depth Model : the total number of matches obtained for each respondent over the 19 stages.

predictors concerned are predominantly Preference or Experience variables. This broad similarity suggests that the four models, though conceptually quite different, operate in similar ways. The remarkable coincidence on the predictor defining the first split leads to the conclusion that though the general model gives good results for persons according high preference to Air, it is inappropriate for those who placed Air low in their preference rankings. Earlier comments about structural bias in the model are thus confirmed.

6.7.2 AID Analysis: Matches

As there has been some evidence that the matches index was not exactly parallel to the rho value in assessments of the models tested it has also been used in an AID analysis.[1] Rather than use a binary dependent variable (match obtained : no match) the value input was derived from the rank position predicted for the first preference mode.[2] Results of this analysis are reported for the four models as before: Primary, Basic, Sequential and Choice Depth.

The first split for the Primary Model was made on Preference : Car (Table 6.21 and Fig. 6.2).[3] Thirty-six percent of the respondents rated car as their first preference

1. The Pearson product moment correlation coefficient for the relationship between mean rho value and number of matches (using the figures given in Table 6.17) was 0.503.
2. The actual value input to the analysis was obtained from:

$$R^* = (R \times 2.0) - 1.0$$

where R denotes the rank position predicted for the first preference mode. This step generated a dependent variable ranging from 1.0 to 11.0 and was required by an earlier stage in the analysis. The transformation would not have affected the interpretation of the results. Note, however, that the use of this dependent variable in the AID analysis requires the assumption that the predicted rank orders conform to an interval scale.
3. Only the first six stages in the AID analysis are presented.

TABLE 6.21 AID Analysis: Primary Model (Model I): Matches

Stage[a]	Parent Group	Split on Predictor	Creates Groups	Categories	Number in Group	Mean Value[b]	Standard Deviation
	A				244	3.03	2.56
1	A	Preference : Car	B	1	87	1.33	1.02
			C	2-6	157	3.97	2.67
2	C	Preference : Air	D	1	125	3.22	1.99
			E	2-6	32	6.94	2.93
3	D	Age	F	Under 20, Not Stated	45	2.16	1.41
			G	20 and Over	80	3.81	2.01
4	G	Rating 1	H	0-4	43	3.30	1.65
			I	5-9	37	4.41	2.22
5	E	Income	J	$301 and Over	14	5.43	2.82
			K	Under $301, Not Stated	18	8.11	2.42
6	I	Experience : Taxi	L	Under 11 Trips, Not Stated	23	3.87	1.65
			M	11 trips and Over	14	5.29	2.71

a. Only the first six stages are reported here.

b. The dependent value for this analysis was the rank position predicted for the first preference mode transformed according to

$$R^* = (R \times 2.0) - 1.0$$

where R denotes the rank position predicted for the first preference mode.

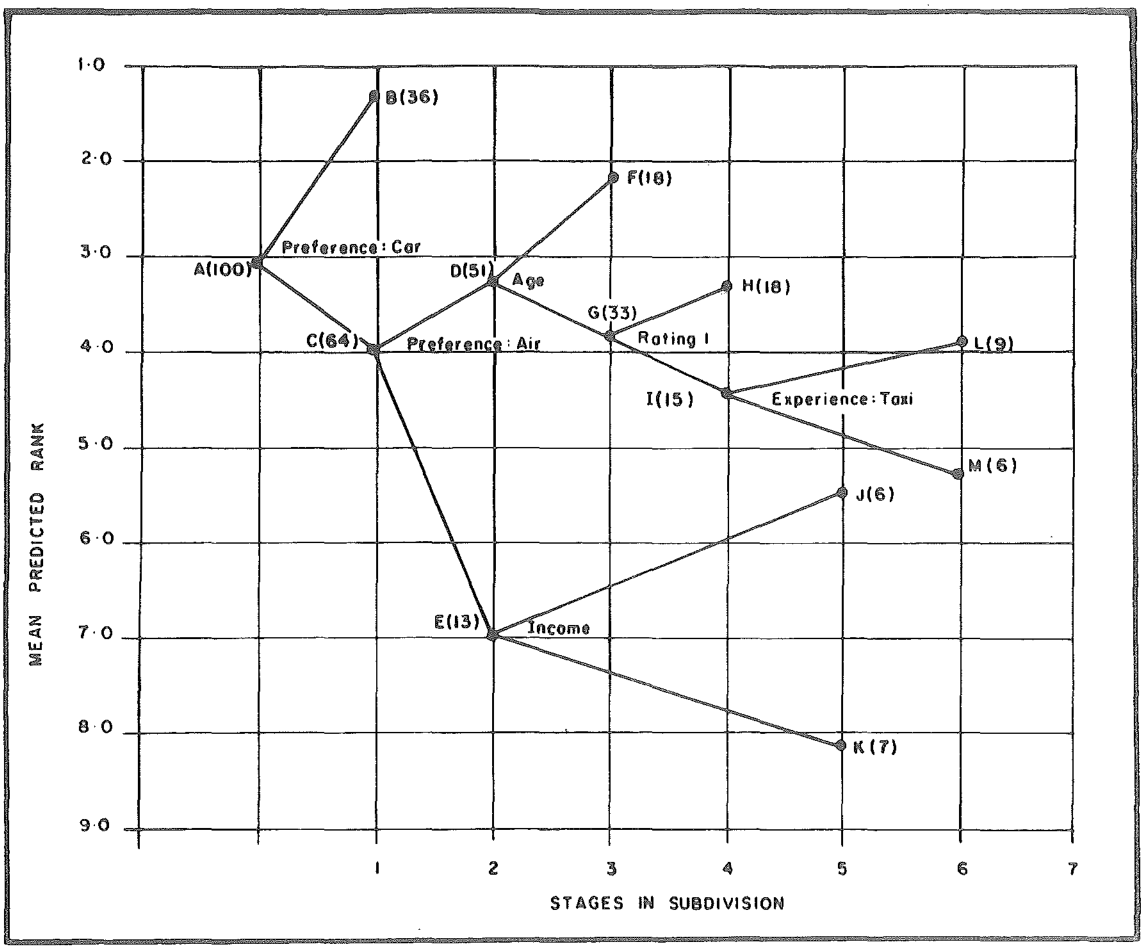

Figure 6.2 <u>AID Analysis: Matches</u>

Subgroups obtained at each stage of the subdivision are identified as in Table 6.21. Numbers in parentheses indicate the proportion of the total number of observations that is contained within each subgroup.

mode and this group revealed a mean value for the dependent variable of 1.33: very close to the 1.0 denoting a match between first prediction and first preference. Despite its size this group remained unsplit till the ninth stage (not displayed here) when removal of those in the youngest age category allowed a sub-group comprising 30 percent of the respondents to reach a mean value of 1.08. At the other end of the scale, the second split on Preference : Air left 13 percent of the study population with a mean value of 6.94 (corresponding to a mean predicted rank position of 4). These people who had selected neither car nor aeroplane as their first preference mode seemed to have very little chance of obtaining a match from the model. Indeed a later split showed that the lower income members of this group were even more poorly predicted by the model.

Very similar results were obtained from the AID analysis of the Basic and Sequential Models (Table 6.20). In all three cases Preference : Car and Preference : Air, respectively, defined the first two splits. The Primary and Basic Models also shared the same predictor, Age, for the third split.[1]

Analysis of the Choice Depth Model again embodied a conceptual difference from the first three analyses. For Choice Depth the dependent variable input to the AID analysis was the total number of matches obtained by each respondent over the 19 stages of the model. Despite this difference the results again repeat the first split based on Preference : Car. The 87 respondents (36 percent) who cited Car as their

1. Age almost had the same effect for the Sequential Model. The "Between Sums of Squares/Total Sums of Squares" ratio for "Age" was 0.094 whereas for "Rating 1", which defined the split, it was 0.109.

first preference mode averaged nearly 14 matches out of a possible 19 whereas the remainder of the study population averaged only four. Details of later splits in the Choice Depth analysis bear only slight resemblance to those found for the other models but the consistency of the first split clearly marks Preference : Car as the crucial variable affecting the prediction of the first preference mode. Regardless of the particular model used, respondents whose first preference mode was car had that preference predicted with considerable accuracy. Conversely, the choices of respondents who cited a mode other than car as their first preference, were poorly predicted by the model. Again it is clear that the decision model as formulated has important structural biases that affect its operation. Matches between the first preference mode and the first prediction are much more likely if Car was cited as first preference.

6.7.3 AID Analysis: An Overview

The AID analyses reported in this selection have pointed clearly to the next steps to refine and further improve the predictive power of the Basic Model. When rho is used to index the model's ability to reproduce the full preference order for six modes, the model has been shown to be most "successful" for persons who rated Air as their first, second or third preference mode. Attention should therefore be focussed on the development of more appropriate models for those persons to whom Air was fourth preference mode or lower.

Similarly, when attention has been concentrated simply on the prediction of the first preference mode, the model has been most "successful" for those who cited Car as their first preference. Further efforts to refine the model should therefore concentrate on the respondents who did not regard Car as their first preference mode.

These are the logical steps that should be taken to improve the Basic Model but in the context of the data and resources available to this study such further work is, unfortunately, impracticable. Firstly, the consistency of the results from the AID analysis suggests that, although good predictions have been obtained for one section of the study population, improvements for the other section will require basic structural changes in the model rather than simply refining and combining the variants studied so far. Secondly, the absence of attribute importance data on two attributes (and especially for Safety) severely limits the practical applications and theoretical validity of any such additional work. Thirdly, the relatively small number of observations available for study markedly reduces the scope for further segmentation of the study population and increases the chance of obtaining purely idiosyncratic results. For these reasons, then, refinement of the model will not be taken further. Instead attention will pass to a brief review of the model's structure and operation.

6.8 A Numerical Decision Model : Summary and Conclusion

This chapter has been concerned with an experiment to see if mode-choice decisions made by inter-city travellers in Malaya could be reproduced by a simple numerical model. Using a semantic differential definition of individual mode images as a starting point, the model derived a surrogate measure of total subjective utility for each mode by summing, over all 19 available mode attributes, the contribution of each attribute weighted by the appropriate attribute importance rating. These measures of subjective utility defined the predicted rank order for the modes which was then compared against the preferred order of choice reported by each respondent. Several variants of The Basic Model were evaluated by means of (a) the number of perfect predictions of all rank positions (b) the "fit" between the predicted and preference rank orders as measured by Spearman's rank order correlation coefficient (rho) and (c) the number of matches between the mode predicted first and the mode preferred first. The initial models revealed a moderate degree of success in predicting mode-choice decisions and attempts to improve the predictive ability of the model led to 3 major conclusions.

1) The models clearly demonstrated that improved predictions were obtained when fewer than half of the available 19 attributes were input to the analysis.
2) Examination of the "best fit" predictions obtained for individual respondents within particular models showed markedly better overall predictability than any single standard model framework.
3) The models showed clear evidence of structural bias toward decisions in which air or car had high preference ratings.

As well as these major conclusions the experiment also left an important question unresolved. It is quite obvious that mode attributes can vary markedly in the importance attached to them by individual respondents. Yet when this effect was built into the model by using ratings of attribute importance to weight the contribution of each attribute the overall level of predictability attained was poorer than that achieved by the (unweighted) Primary Model.

Despite this paradox and the problem of structural bias the results of the experiment are modest but encouraging. With some sub-models consistently generating mean rho values over 0.700 and more than 50 percent matches it is clear that the family of models discussed does go a long way toward defining a simple numerical model for predicting mode-choice decisions. At the same time, however, it must be stated that the experiment remains essentially incomplete. The attempt to forge a link between measured cognitions and the behaviour resulting from those cognitions has been only partially successful. Much more work is required before we can be fully confident of the validity of image measures or of models designed to predict behaviour from them. The problems met during, and the conclusions drawn from, this experiment have pointed out a number of directions that further work should follow. Chapter Seven critically reviews this whole study setting the major sections of it into some perspective with each other and outlines some of the major implications of its findings.

CHAPTER SEVEN: CONCLUSION

Three explicit objectives were established at the beginning of this thesis. They were: 1) the collection of basic information on the mode-choice decision and the evaluation of its relevance for the understanding of transport patterns, 2) an examination of the oft repeated assertion that individuals with similar characteristics reveal similar attitudes, perceptions and decision-making processes and 3) the development and testing of an integrated model of individual decision behaviour. These objectives were approached by means of data, collected in Malaya, on the mode-choice decision for inter-city travel. The In-transit Survey was conducted among persons about to undertake, or actually in the course of, an inter-city journey and sought information on the knowledge held of the context of their mode-choice decisions and also on the main criteria used to evaluate modes of transport. Chapters Three and Four reported on the analyses of these data. Several informal groups of respondents (including school pupils, university students and government servants) participated in the Mode Image Survey which used a semantic differential to measure individual cognitions of particular modes. These data were summarised in Chapter Five and then, in Chapter Six, used in a series of numerical models designed to reproduce the mode preference rankings reported by each respondent. All three objectives were carried forward throughout these substantive chapters and major findings were summarised at the end of each one. The intention here, is not primarily to repeat those summaries, but rather to critically review the conceptual and procedural under-pinnings of this study insofar as they affect the three objectives and also to highlight major points needing revision or further investigation. This review will be carried out for each of the objectives in turn.

7.1 The Mode-Choice Decision and the Understanding of Transport Patterns

Investigations of transport patterns in terms of mode-choice decisions that generated them, should provide an ideal way of reaching an understanding of the distribution of travellers among the available modes. Certain problems met in the course of the present study, however, reduce the substantive value of the data for either a general understanding of travel patterns or for specific planning applications. These problems focus mainly on 1) the lack of any attempt to systematically sample the travellers using a particular mode, 2) the very low response rate achieved by the In-transit Survey and 3) the uneven distribution of responses across the six modes studied. Because of these difficulties the results obtained cannot validly be generalised to any population of actual or potential travellers. Furthermore, any general conclusions drawn from the data are biassed toward the responses given by motorists as this mode contributed almost one third of the data. Any attempt to provide for the fair representation of each mode in the In-transit Survey would have required much more information on actual travel movements than was available when the Survey was carried out.[1]

1. Appendix 1 shows that, even for the five routes with data available, the role of car in inter-city travel varied from 12 percent of total movements to 48 percent.

Even if the information necessary to develop a systematic sampling frame (both within and among modes) had been available, the likelihood of a low response rate from self-administered questionnaires would have still been present. Much better response rates can usually be obtained from personal interviews. For mode-choice studies the interview could be directly tied to travel situations (interviews in the travel vehicle, at traffic cordons or mode terminals) or independent of them (household interviews, interviews oriented to the "place of employment" as in the Mode Image Survey). Such procedures would also allow the use of more sophisticated questioning techniques and permit deeper probing than was possible with a self-administered questionnaire. Furthermore, they help highlight the important distinction between "decision knowledge" and "general knowledge". The first, "decision knowledge", refers to data which relate to a specific overt action and can be used to explain the decision that led to that action. "General knowledge", on the other hand, is not tied to a particular action but is presumably readily available to the decision-maker and could well influence any future actions. This distinction raises the problem of which kind of information is most useful. This study has argued that, because human knowledge is continually subjected to new ideas, information and perspectives, "decision knowledge" would contribute most to an understanding of travel patterns. It would be interesting, however, to conduct two otherwise identical studies to see if "decision knowledge" was, in fact, significantly different from "general knowledge".

Other, more detailed, problems can also be noted. Some are partly a function of the self-administered questionnaire, like the use of (prompting) response alternatives for the choice context questions and the occurrence of incomplete or inconsistent responses. These problems might be minimised by a more carefully structured questionnaire or a changed methodology. Difficulties also arose in the analysis and interpretation of the data from the In-transit Survey. Mention was made in Chapter Four of the possibility of distortion arising in the grouping of the mode-choice reason and mode disadvantage responses. One could also question the validity of combining these to generate mode descriptors. Is one reason equivalent to one disadvantage?[1] A similar problem concerns the temporal stability of these data. Would a motorist (or a bus passenger) justify his choice of mode in the same terms each time he makes an inter-city journey by the same mode? To what extent do reported disadvantages depend on the specific happenings of the surveyed journey and to what extent are they general cognitions of that mode? What is the test-retest reliability of the semantic differential when measuring mode images? Can the semantic differential be used to index temporal changes in images? Clearly there is a need for a great deal of empirical research into these questions about the temporal stability of cognitive data. One final point concerns the form of the semantic differential used in this study. As discussed in Section 2.3.2.2 the traditional

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1. Note that disadvantages were reported for the chosen travel modes and so they clearly did not outweigh the attractive features of that mode when the individual decisions were made.

format of the semantic differential was changed so that respondents could indicate any scales that they felt were irrelevant for evaluations of particular modes. Analysis of the "irrelevant scale" data left the (unsupported) suspicion that respondents were reluctant to use this option. Perhaps respondents felt that the "irrelevant scale" response could imply that they did not think carefully when replying to the questionnaire.[1]

Two basic conceptual problems also affect the substantive value of these surveys for reaching an understanding of travel patterns. First, little attempt was made to investigate the motivation to travel, the choice of destination, the choice of route, the choice of timing and the degree of urgency associated with the journey. All or any of these factors could have a considerable influence on individual travel behaviour. Yet very little is known about the order in which these decisions occur (apart, presumably, from the decision to travel) or the interdependencies that hold among them. Second, although the two surveys were designed to be complementary the two sets of data so obtained are not strictly comparable. The In-transit Survey was tied to a specific journey and generated data on "decision knowledge". Those data helped define the 21 scales used in the semantic differential but the Mode Image Survey did not relate to an

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1. Data collected on travel experience during both the In-transit and Mode Image Surveys also suggested that there might be a tendency to avoid negative or non-positive responses. Despite the provision of a response category "Never travelled", the travel experience variables revealed a relatively high proportion of "no responses" (See Appendix 4). It appears that some respondents gave valid responses for modes they had experienced but left the others blank ("no response") rather than marking the "Never travelled" category.

actual journey and so it has provided information on "general knowledge". More valuable data would have been obtained if the same respondents had participated in both surveys. However, it would have been difficult to arrange such "double" surveys successfully and, at the same time, retain at least some focus on "decision knowledge".[1]

Yet despite these various problems certain general points can be made about mode-choice decisions affecting inter-city travel patterns in Malaya during 1970. Data from the In-transit Survey showed that travellers were not, in general, fully aware of the objective choice context and they tended to even further reduce the set of modes recognised as available before a choice was made. A wide range of criteria was used to evaluate modes of transport. Responses to the mode-choice reasons and mode disadvantages questions clustered into some prominent categories but no single category obviously dominated all others. Knowledge of certain "objective" characteristics of modes and journeys was shown to be prone to considerable error.[2]

Although mode-choice reasons identify "prime selling points" and mode disadvantages indicate "problems requiring attention" information obtained from the Mode Image Survey could be regarded as the data most immediately useful for transport operators and planners in Malaya. If it is

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1. An attempt to do this was made by sending Mode Image questionnaires to each of the 151 In-transit Survey respondents who gave their name and address. Only 9 of the 43 respondents that returned this questionnaire revealed valid "inter-city" journeys on the In-transit Survey and so a separate analysis was not considered worthwhile.
2. This finding implies that changes in mode patronage cannot be simply determined from changes in relative (objective) performance.

assumed that the results from this survey broadly represent the views of potential travellers then the mode image data indicates, for any given mode, the particular semantic scales on which it is seen to be superior, similar or inferior to its competitors. Transport operators and planners could use this information to identify those attributes that could be objectively manipulated or positively "advertised" to improve the competitive position of a particular mode. Operators of inter-city buses and taxis might also be interested to note the tendency for these modes to be associated with some of the less attractive characteristics of their intra-urban equivalents. Independent corroboration of this finding could lead to major publicity campaigns designed to correct these "erroneous" impressions.

Although this study has not made a major contribution toward the solution of specific problems facing transport planners and operators in Malaya, it has attempted to indicate the potential value of data on the mode-choice decision. Furthermore it has demonstrated what can be done with relatively simple survey methodologies and also explored a variety of analytical techniques that help provide additional insight into complex decision-making processes. Discussion of the various difficulties met in the course of this study could help provide some guidance for the design of surveys to provide information needed to deal with specific transport problems. Perhaps the most important point for planners and operators comes from the finding that knowledge of the choice context and the use of particular reasons and disadvantages did not correlate strongly with the characteristics of individual travellers. Successful predictions of future patronage are, therefore, unlikely to be derived by simply projecting the characteristics of the population "at risk". The approach followed here argues that travel behaviour is a function of the objective choice context, cognitions of that context, subjective images of the alternatives and the relative weighting of the criteria that contribute to the images. Change in behaviour could result, therefore, from change in any one or any combination of these factors. Predictions of future patronage are likely to be much more complex than the projection of a single factor.

7.2 Ecological Clustering in Cognitions and Decision Processes

Much research has followed the general assumption that similar people behave in similar ways for similar reasons. In this study the assumption was taken as an hypothesis to be tested in terms of inter-personal variations within data indexing several different aspects of the mode-choice decision. These aspects included knowledge of the choice context, criteria used in the evaluation of modes, mode images, mode preference rankings and attribute importance ratings. The variables tested comprised three main groups: 1) standard socio-economic indices (sex, age, income, occupation and race) with the addition of two mode ownership variables (car ownership and motorcycle ownership), 2) travel experience variables for the six "inter-city" modes and a computed estimate of total travel experience and 3) situational variables indexing the nature of the journey undertaken (In-transit Survey) or defined for the respondent (Mode Image

Survey).

Relationships between each aspect of the mode-choice decision and the various indices were computed from either contingency table or multivariate analysis of variance (MANOVA) procedures. As statistical tests of significance were inappropriate, the degree of association between each pair of variables was assessed by Cramer's V^2 for the contingency table analyses and eta-square in the case of MANOVA. Results obtained from particular analyses were summarised at the end of each chapter. The opportunity is taken here to provide an overview of all these tests and to state any general findings. The relative importance of each variable within a particular analysis was expressed in terms of its rank according to the strength of relationship with the test variable. Summing these ranks across all tests provided a crude summary measure of the relative role of each variable in differentiating major elements of the mode-choice data (Table 7.1).[1]

Interpretation of Table 7.1 is complicated by differences in the variables examined, the fact that each column summarises a range of measures and by the lack of information, apart from the ranking itself, on the relative strength of the relationships. Nevertheless some brief points can be made. Car Ownership and the Trip Nature variables seem to have most influence on the context and descriptors measures. Apart from Income (choice context) and Ethnic Group (descriptors) the standard socio-economic indices are

1. See Appendix 7 for the detailed tables that contributed to Table 7.1.

TABLE 7.1 Ecological Clustering in Cognitions and Decision Processes : Summary

Variables	Mode-Choice Context[a]	Mode Descriptors[a]	Mode Images[a]	Mode Preferences[a]	Attribute Importance Ratings[a]
Personal Characteristics					
Sex	14	9=	12	15	17
Age	16	15=	2	2	2
Income	4	12=	3=	3=	3
Occupation	9=	15=	3=	8	10
"Place of employment"	-	-	1	1	1
Ethnic Group	11	5=	5	10	6
Ethnic Group[b]	-	-	9	14	7
Car Ownership	1	2	10	11	18
Motorcycle Ownership	6=	12=	11	7	19
Travel Experience					
Travel Mode Experience[c]	12=	9=	8	-	-
Total Travel Experience	12=	11	6	17	14
Travel by Air	5	3	-	19	16
Travel by Bus	15	19	-	12	9
Travel by Car	9=	7=	-	6	4
Travel by Motorcycle	-	-	-	3=	8
Travel by Taxi	18=	20	-	9	13
Travel by Train	18=	17	-	16	11
Trip Nature[d]					
Travel Mode	3	1	-	-	-
Travel Route	8	4	7	13	12
Trip Destination[e]	-	-	13	18	15
Trip Purpose (Trip Type)	2	5=	14	5	5
Trip Payment	6=	7=	-	-	-
Size of Travel Group	17	14	-	-	-
Mode Choice Context					
Practicable Modes Code[f]	-	18	-	-	-

(contd)

TABLE 7.1/contd.

a. The numbers in each column indicate the rank order of the variables in terms of their overall strength of relationship with the particular set of cognition-decision measures. These ranks are derived from the tables in Appendix 7 by summing the values in each set and then ordering the variables according to that total. Rank 1 identifies the strongest overall relationship and rank 19 (or 14 in the case of the mode images measure) the weakest. Tables 3.5 and 5.11 define the variables used.

b. Excluding the heterogeneous "Other" group.

c. For each mode image measure, analysis of travel experience was carried out only for travel by the same mode. It did not seem reasonable to expect, for example, that travel experience by air could logically affect the image held of train.

d. Note that, in the Mode Image Survey, the travel route and trip type were specified after the mode image section of the questionnaire.

e. Excluding respondents resident outside Selangor.

f. This variable was defined by the mode combination code calculated, for each respondent, from the practicable mode set.

comparatively unimportant. Travel Experience by Air is the only other variable that has a prominent effect here. The mode images, preferences and attribute importance measures reveal quite different relationships. All three are consistently related to "place of employment" and Age (which together make up the suggested "behavioural maturity" dimension) followed by Income. The Car Ownership and Trip Nature variables have little impact on these measures.

There seem to be at least two possible explanations for the different pattern of relationships found for the measures obtained from the In-transit Survey compared with the pattern from the Mode Image Survey. First, the difference might have arisen because the two surveys involved completely different types of people with distinct cognitions and decision processes. An examination of Appendix 4 soon shows that though the two groups are not identical there are substantial similarities. The second, and more attractive, possibility is that the two surveys generated quite distinct types of information and that each type, because of its nature, reveals different patterns of relationships. This recalls the earlier discussion of "decision knowledge" and "general knowledge". It could well be that "decision knowledge", information on actual mode-choice decisions, is related primarily to variables indexing the decision situation and that "general knowledge", not tied to an actual decision, is affected most by the "behavioural maturity" and income of the respondent. If the two types of data <u>are</u> distinct, and it must be recalled that the actual strength of the relationships reported in earlier chapters was not great, then there are important implications for the utility of attitude and image data in transport plans. Information collected during standard household surveys would constitute "general knowledge" and would not necessarily help explain or predict actual travel behaviour. Clearly the possible distinction between "decision knowledge" and "general knowledge" needs a great deal more work before the point can be resolved.

Brief mention should also be made of a number of more detailed aspects of the present study. Any conclusions that might be drawn about ecological clustering in cognitions and decision processes depend largely on the range and nature of the variables tested. One variable not examined here and possibly very important in transport decisions is the urgency or "time pressure" associated with the journey. Furthermore, geographers have been showing increased interest in the role of personality in environmental behaviour and this factor might also be important in mode-choice. The assumption was also made that an individual's image of any mode was a general construct independent of travel route or trip purpose. Unfortunately it was not possible to test this assumption as the specification of route and purpose in the Mode Image questionnaire was done <u>after</u> the semantic differential had been completed. Any correlations revealed between mode images and route or trip purpose would therefore be spurious. The point clearly deserves further attention.[1]

1. This is particularly so because the preferred formulation of the present choice model (the Basic Model) implies that choice is made, not on the basis of the images alone, but in terms of the differential evaluations placed on various aspects of those images according to the nature of the decision situation.

Certain technical difficulties should also be noted. Some of the contingency table tests could not be completed because of highly skewed distributions. MANOVA analyses of the mode preference data assumed that the preferences conformed to an interval scale. Except at a purely qualitative level, it was not possible to make direct comparisons, between the In-transit Survey and the Mode Image Survey, of the strength of relationship revealed by particular variables. The data available from the two surveys did not represent a statistical sample of either travellers or potential travellers.

Despite these various assumptions and difficulties, however, it is possible to draw a few broad conclusions from the reported analyses. Knowledge of choice context as well as stated choice reasons and mode disadvantages did not reveal any strong consistent relationships with variables indexing personal characteristics, travel experience or trip situation. The relationships revealed by the mode images, mode preferences and attribute importance data focussed on "place of employment", Age and Income but were still not exceptionally strong. There is evidence that variables other than the standard socio-economic measures should be considered in cognitive-behavioural studies. Indices of personal experience and decision situation clearly deserve attention. Finally, the quite different patterns of relationships revealed for the two sets of data raise an important question about the distinction between "decision knowledge" that is tied to a particular decision or action and "general knowledge" that has no such anchor in reality.

7.3 An Integrated Model of Individual Decision Behaviour

The major elements of the model formulated and given operational definition in Chapter Two were analysed in Chapter Three (choice context), Chapter Four (mode descriptors) and Chapter Five (mode images). Chapter Six put these elements together and attempted to use the measured mode images to reproduce the mode preference rankings reported by each respondent. Discussion of the formulation and testing of the cognition-behaviour model will be carried out in two parts. First, the specific framework and procedures adopted in this study will be reviewed. The second part briefly evaluates the implications that the development of this framework in the context of mode-choice has for its general application to other fields in human geography.

7.3.1 Conceptual Framework and Operational Definition

It should be recognised that the model discussed in this study was formulated and tested in the context of a relatively simple example of decision behaviour. Mode-choice decisions for passenger travel are not complicated by conflict between private attitudes and public behaviour that can arise with policy issues or race relations. Nor are they usually affected by uncertainty concerning the "payoff" or utility of a selected alternative because of marked and unpredictable changes in the "state of the environment".[1] For public

1. Some examples of uncertainty do occur: the motorcyclist can be drenched by a sudden downpour, roads can be blocked by floods or unusually heavy traffic, fog can cause the cancellation of scheduled flights and labour disputes might disrupt train or bus services. In general, however, these problems are rare or can easily be circumvented. Inter-city travellers usually seem to make their choice of mode without considering the variable states of the environment.

transport, at least, economic issues in the decision are relatively clear cut and easily isolated. The alternatives that have to be evaluated are discrete objects that are not divisible. Only one mode of transport can be used by a traveller at the one time. For these reasons, then, the mode-choice decision would seem far easier to model than many of the decisions studied in human geography and so one might reasonably expect to achieve a relatively high rate of success with such a model. While the results obtained from the present model were encouraging, the rate of correct predictions was not high. Both conceptual and operational reasons help to explain this shortfall.

Attempts to explain the failure of the model to reach expectations focus, at the broad conceptual level, on two main points: first, the assumption of rational decision-making and second, faults in the specification of the model. These two points will be discussed in turn.

(a) the assumption of rational decision-making

The choice model, as formulated here, assumes that actors examine each of the alternatives available to them and then select the one, in terms of their subjective images of those alternatives, that best suits the requirements of a particular journey. Leaving aside the question of the adequacy of the measurements used in the model, there is the possibility that respondents did not rationally evaluate the alternatives and choose the one with the "best" image but acted more according to idiosyncracy or a moment's whim. In fact it may be that the choice model provides an opportunity of assessing the role of the irrational or idiosyncratic element in choice behaviour by revealing the number of decisions that were not correctly reproduced. Discussion of the various models examined in Chapter Six showed, however, that the "rate of success" varied according to the nature and configuration of the particular model used. At what point among the various models and sub-models would the line be drawn so that all respondents without a correct prediction could be classified as "irrational mode choosers"? Would a person, with only one correct prediction after the application of several different models, necessarily be a "rational decision-maker"? There are no objective answers to these questions. Furthermore, it should be noted that the use of mode preference rankings, rather than overt choice, as the behaviour to be modelled probably increases the "irrational" or "unpredictable" component in this study. As the first preference mode did not have to be implemented it was relatively easy for a respondent to indulge in "wishful thinking" instead of reporting a realistic preference in tune with his mode images.[1] More precise wording of the relevant question and a careful screening of responses might help reduce the element of "wishful thinking" but there is no reason to suppose that it could be removed entirely from preference statements. Although irrational decision processes could well be important in behaviour patterns they do not offer an entirely satisfactory explanation for the sub-maximal performance of the choice model.

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1. Note, for example, the potential for "wishful thinking" involved in asking school students to evaluate a mode for business travel.

(b) faults in the specification of the model

One of the main concerns underlying this study was the need (identified in Chapter One) to validate image measurements by developing an explicit link between the image and the behaviour assumed to spring from it. It is not claimed, of course, that the model presented exactly replicates the mental processes involved in decision-making. If, however, the model could reproduce the preference rankings one could have considerable confidence in the validity of the image measurements. Further consideration of this approach reveals the logical difficulty that it involves. The model cannot validate the image measurements because the structure of the model is, itself, an hypothesis. There is, in fact, a variety of structures that might have been employed and any one of them might give a better (or poorer) performance than the simple additive one used here.[1] It is also conceivable that invalid image data coupled with an inappropriate model could generate good predictions of the preference rankings. The model used here seems to be a logical representation of the choice process but many more studies over a range of choice problems would be required before it could be regarded as anything more than an initial hypothesis.

As well as these two major conceptual problems, a number of operational difficulties should also briefly be reviewed.

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1. Other models might be multiplicative, based on multiple regression or rely on non-Euclidean metrics. Hoffman (1968) has suggested a configurational model in which the evaluation of a particular scale depends on the value associated with it <u>and</u> on the values associated with other aspects of the image.

(a) mode context

Information on the subjective choice context was not collected by the Mode Image Survey. Operation of the model therefore imposed a common choice context on all respondents. Special sub-models were developed to vary the choice context (Models IV and V) but they concentrated on the distinction between public and private modes and made no allowance for individual differences. The inclusion of spurious altern-atives in the choice context could greatly affect the accuracy with which individual preference rankings were reproduced and, hence, the overall performance of the model. Clearly, the Mode Image Survey should have avoided this difficulty by collecting information on choice context thereby allowing each respondent to specify the modes that entered the model of his decision.

(b) attributes in mode images

Several problems arise from the attributes (or semantic scales) on which the mode images were measured. The use of scales identified by the In-transit Survey helped generate the bias to attributes most relevant for the evaluation of car that was noted in Chapter Six. It has also been suggested that respondents were reluctant to indicate that they viewed particular scales as irrelevant for evaluating a given mode. One way of avoiding this kind of problem would be to use a personal construct methodology and allow each respondent to specify the scales that were most relevant to him. Existing procedures for this methodology require the presence of the researcher (or an assistant) while each respondent was completing the questionnaire. This was impracticable for the present study. We should also note that the scales used for the semantic differential effectively covered only the evaluative aspects of mode images. It could be that some people react, in part, to the less concrete, more symbolic aspects of images. Obtaining reliable data on the symbolic elements of mode images would have been very difficult in a multi-cultural setting like Malaya. A more basic problem lies in the possibility that some of the scales were not linearly related to "attractiveness" or "utility". Most people, for example, would prefer a fast mode of travel over a slow one but it could be that very high speeds are seen as unsafe and therefore undesirable. Similarly, an air-conditioned vehicle can add greatly to travel comfort in a tropical country but too much cold air could make the journey very uncomfortable. With scales like these, the optimum or most favourable value lies somewhere intermediate between the two poles. This contradicts the rationale of the choice model which implies that all scales made linear contributions to total mode utility. More empirical research is clearly required to find out which scales are, in fact, non-linear and how they might be incorporated into a choice model.

(c) attribute importance ratings

This study assumed, as a general principle, that mode images were independent of the particular circumstances of a given journey; that they simply represented knowledge that did not necessarily predispose the actor to a particular decision. It was assumed that the actual decision process was set in motion by the definition of a particular choice situation because that situation (or the actor's cognition of it) indicated how the various criteria that entered into the decision would be valued relative to one another. Thus a particular individual might value "Speed" and "Punctuality" for a business trip whereas for a holiday trip he would weight "Relaxation" and "Flexibility". This process was made operational by having respondents rate each attribute according to how important it would be in their choice of mode for a specified journey. It was surprising to find, however, that the use of weights derived from these importance ratings did not improve the ability of the model to reproduce the preference rankings. Part of the problem was seen to be the failure to collect importance ratings for either "Safety" or "Relaxation" but there is also the question of respondent reaction to the format on which the ratings were obtained. Relatively little use was made of the "Unimportant" side of the scale.[1] This would have reduced the amount of discrimination possible among the various attributes and blunted the effect of the weighting system. Collection of the importance ratings on the same format as was used for the mode image data might have helped minimise this problem.

(d) model mechanics

The choice model "evaluated" the modes for a given respondent by summing the mode image values, weighted according to the appropriate attribute importance rating,

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1. Only 36.8 percent of the respondents used the "Very Unimportant" rating at least once. More than two-thirds used the "Quite Unimportant" rating but together these two categories were used a total of 518 times. If respondents had spread their importance ratings evenly over the scale these two categories would have been used 1854 times. See Table A5.8 for details.

over all scales to derive a "total score" for each mode.[1] These total scores were divided by the number of valid scales that contributed to them and the best resultant value identified the predicted first choice mode. This simple additive procedure is only one of a number of mechanisms that could be used.[2] Although the additive model is logically appealing there is no strong evidence to support the choice of any one mechanism over the others. Many tests are required to assess the relative performance (and suitability) of these mechanisms over a variety of situations. Two other more detailed points should also be made. The first queries the use of an averaging procedure to circumvent the problem of "irrelevant" scales or missing data. It could be argued that, if a person viewed one or more scales irrelevant for a given mode then less information on that mode entered the decision. If this was the case then the "score" on which the prediction was based should logically be the total rather than a mean score per relevant scale. The second point concerns the reliance on the calculated best score for the prediction. This is a "maximising" procedure whereas much of the literature on choice processes emphasises the notion of "satisficing" behaviour in which alternatives are examined in succession until a satisfactory alternative is found.[3] In a mode-choice situation like the present where there was a maximum of six alternatives the idea of a sequential search among alternatives might seem unnecessary.

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1. Table 2.2 gives the formulae for this procedure.
2. See footnote 1 on page 304.
3. See, for example, Simon (1957), Wolpert (1964), Harvey (1969), Pred (1969) and Hansen (1972).

The satisficing concept could be applied, however, to the sequential consideration of attributes until one alternative was seen to be satisfactorily better than the others. As with most studies of satisficing (or search behaviour) the main problem is to define a realistic and fair "order of search". A similar difficulty was encountered with the Choice Depth Model (Model III) although it was not concerned with satisficing behaviour. The crude (and circular) solution adopted there was to use the mean importance ratings to define the order in which the scales entered the problem. Model VI (Sequential Decision Making), however, used the importance ratings to define a five-step decision sequence that might also form the basis of a satisficing mechanism.

(e) response

The problems of using preference rankings as the behaviour to be reproduced have already been examined in some detail. Use of preference rankings did remove the effect of the time lag between the decision and data collection but in all other respects they were unsatisfactory. The choice model needs to be tested with data on decisions that led to overt actions.

The above review of the performance of a cognition-behaviour model in the context of the mode-choice decision has highlighted a number of aspects requiring further attention and identified particular lines for further research. Comments made at the beginning of section 7.3.1, however, suggested that mode-choice decisions offered relatively simple and straightforward subjects for numerical modelling. Section 7.3.2 examines some of the implications of the model developed in this study for its application in other areas of human geography.

7.3.2 General Application of the Cognition-Behaviour Model

As there is an infinite number of possible applications for a cognition-behaviour model in other areas of human geography, this review will concentrate on three of the broader implications of the present framework: first, the choice context, second, the "reach" of the model and third, the distinction between "general knowledge" and "decision knowledge".

(a) the choice context

A great deal of emphasis in this study has been put on the need to be aware of the choice context as it appeared to the decision-maker. With a relatively small number of discrete alternatives, the problem of specifying either the objective or subjective choice context is fairly simple in transport research but the situation is very much more complex in most other fields.[1] Studies of location decisions, whether they involve manufacturing plants, retail establishments or residential locations, would require that continuous geographic space be broken up into a multitude of discrete sites so that each could be evaluated. Resource use decisions are probably even more complex because they involve two decisions (real or by default) for each and every areal unit being managed: the first concerns the selection of a

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1. Only in studies of voting behaviour would the range of alternatives be as clear cut as in mode-choice studies.

particular resource use for a given unit and the second involves a decision on the intensity with which that use should be implemented. A farmer has an infinite array of alternatives theoretically available to him from the various combinations of use and intensity. Problems in the identification of alternatives are particularly serious for the framework presented here because the choice model assumes that images can be measured and evaluated for each of the alternatives considered. These difficulties serve to emphasise the need to find out how decision-makers structure the environment and recognise alternatives. Does the locational decision-maker follow a strict hierarchical procedure choosing first among regions, then among localities within the chosen region and finally among sites within the best locality? Does the resource manager work from broad categories of use and intensity to finer ones? It is important to be aware that known alternatives can greatly constrain decision processes and the resultant behaviour. Many more studies are required in all fields of the ways that decision-makers view the choice context.

(b) the "reach" of the choice model

Mode-choice decisions for inter-city travel are usually "one off" decisions: the traveller makes a separate decision for each journey. Some aspects of geographic behaviour, however, are repetitive or even habitual and research into them would be greatly simplified if reliable "many off" choice models could be developed. Each prediction by a "many off" model would identify, for a given individual, a frequency distribution of behaviours over a certain period of time rather than a single selected alternative. Such models would obviously simplify the task of studying situations where each individual made repeated actions, not all necessarily identical. R. Hudson (1972), for example, modelled shopping behaviour over a ten-week period in terms of the probability of visiting each of the shops recognised by the respondent. The present formulation relates specifically to a "one off" situation. It would be possible of course, to use the final "score" calculated for each mode to derive probability estimates of the relative use of the various alternatives in a particular time interval. Such a procedure requires the assumption that mode images would remain sufficiently stable over the period so that a prediction made at the beginning of the period was still valid at the end. More important, however, is the lack of a clear rationale for equating the final mode scores with the probability of use of each mode.

(c) "general knowledge" and "decision knowledge"

One of the important findings of this study focussed on an apparent distinction between "decision knowledge" related to actual choice behaviour and "general knowledge" collected without reference to real world actions. If this distinction is verified by other studies that show "general knowledge" to be of little use in explaining overt behaviour then there are important implications for cognitive-behavioural research. Research that aspires to understand or explain behavioural patterns would have to monitor actual decision processes rather than relying on "armchair" surveys of attitudes and images. As the traditional household (or classroom) survey techniques can rarely get close to actual decisions this would also imply the development of new methodologies that would allow the researcher to catch behaviour "in progress". Discussion of the In-transit Survey indicated the difficulties experienced in trying to get as close as possible to travel decisions. The problems would surely be much greater for attempts to study relatively rare and "high cost" behaviour such as migration decisions or the choice of an industrial site. Two approaches seem likely to offer prospects for dealing with these difficulties. First, simulation procedures should be examined to see what kind of techniques can generate realistic simulations and so provide "decision knowledge" rather than "general knowledge". Second, there is an urgent need to examine temporal decay in images and in the recall of decision processes so that the interval before "decision knowledge" begins to change and shade into "general knowledge" can be identified and used to evaluate the data obtained from behavioural studies.

Although many more highly detailed points could be made, the three issues discussed above seem to have the most important implications for the general application of this (or any other) cognition-behaviour model within the various fields of human geography. Some brief final comments conclude this thesis by highlighting one additional issue that seems crucial to the continued viability of the behavioural approach in human geography.

7.4 Concluding Remarks

The preceding sections of this chapter have reviewed the conceptual and procedural underpinnings of the present study.

Several suggestions have been made for further work but these focussed on refining the basic model or on adapting it for applications other than mode-choice. Little consideration was given to the wider context of cognitive-behavioural research and so some comments are now directed at this issue.

Most cognitive-behavioural studies in geography aim at an understanding of the decision processes that generated a particular behavioural pattern. Many also tend to imply that the understanding, once gained, will provide a basis for the prediction of future patterns. The fallacy in this position lies in the logical impossibility of making any sound predictions of the future from single cross-section studies. It also obscures the almost total ignorance that researchers have of temporal change (and temporal stability) in environmental images. There is little information on the test-retest reliability of the main measuring techniques. Although some geographers have worked with learning models we know very little about how images grow and change, what sources of information contribute to their development, the rate of change of images in different situations or between different people, whether individual images are essentially stable from day to day, the nature of long term trends and what effect an increment of knowledge has on overt behaviour. Until these and other crucial questions have been answered there are very few grounds for confidence in the behavioural validity of measured cognitions. The only other apparent approach to the validation of environmental images would seem to lie in the repeated application of a cognition-behaviour model (such as the one proposed in this study) to the same persons over a variety of changing environments, images and overt behaviours. Only if the model performed successfully under these conditions could one have confidence in both the model and the image measurements. In either case, the behavioural approach needs a great deal of very basic research before it can even start to fulfil its inherent potential.

APPENDICES

Appendix 1: Estimates of Modal Split on Selected Routes

As no estimate of the split of passenger travel among the main modes could be located for Malaya, data were collected during the present study in an attempt to provide some measure of the split on selected routes. Origin-destination data for April 1970 were obtained from the Department of Civil Aviation, Malayan Railway Administration and Law and Company (for bus services).[1] Similar information on car, taxi and motorcycle travel was obtained from the Highway Planning Unit survey at Tanjong Malim (September, 1969) and from the Malaysian Highway Feasibility Study (August, 1970).[2] Average daily flow figures obtained from these two surveys had to be expanded to monthly totals and then weighted according to traffic levels at the Selim River Toll House to give estimates for April 1970. Table A1.1 sets out the information derived from these various sources and Table A1.2 presents the estimated modal splits.

Any attempt to interpret these tables should take note of certain problems that affected their construction.

(1) The car, taxi and motorcycle figures were based on average daily (or 16 hour) counts which had to be expanded and weighted to make them comparable with the air, bus and rail data which were in the form of monthly totals. In

1. I am most grateful to Mr C.H. Moreira (Director of Civil Aviation), Encik Waad bin Jamaluddin (General Manager, Malayan Railway Administration) and Mr Loo Eng Kee (Law and Company) for permission to use these data.
2. Encik Nordin bin Kidam (Highway Planning Unit) kindly allowed me access to material from the Tanjong Malim Survey. Details of the survey procedure can be found in Yunit Peranchang Jalan (1970). I am indebted to Mr T.A. Atkinson of Valentine, Laurie and Davies (Consulting Engineers) for permission to use information from the Malaysian Highway Feasibility Study.

making these calculations it was necessary to assume (a) that the actual survey periods were representative of the month as a whole and that a total for the month could validly be derived by using a simple expansion factor and (b) that the temporal variations in traffic levels at the Selim River Toll House closely reflected the variations at the actual survey sites. These assumptions do not seem unreasonable but substantial discrepancies between the estimates for car and taxi travel on particular routes derived from the two surveys help emphasise the fact that the final figures must be treated with caution.

(2) It was necessary to assume that the "catchment" areas were identical for all modes. This is most unlikely. Air, in particular, would have a much larger "catchment" area than the other modes. A traveller living in Kelang, for example, wishing to fly to Singapore would emplane at Subang and thus be included in the airport statistics for Kuala Lumpur. If, however, he travelled by train he could buy his ticket in Kelang and so would not be recorded in the Kuala Lumpur figures. As no information could be found on the relative catchment areas it was not possible to carry out any adjustments to make the data more comparable. Similar problems occur with the car, taxi and motorcycle data derived from traffic surveys. The total number of persons recorded as travelling between a given origin and destination is affected by (a) how specific the traveller was when he reported his place of origin and place of destination and (b) the particular set of origin and destination zones used for the

survey.[1]

(3) On four of the six routes covered in Tables A1.1 and A1.2, the modal split was calculated from incomplete data. Most serious was the lack of any information on car and taxi travel between Ipoh and Georgetown/Butterworth. On a route of this distance (110 miles) it would be likely that both modes would make a substantial contribution to the total amount of travel.[2] Motorcycle would probably not take much more than 1 percent of the travel on any of these routes. The missing data for bus on the Singapore-Georgetown/Butterworth route is, in fact, incorporated within the figures given for the Singapore-Kuala Lumpur and Kuala Lumpur-Georgetown/Butterworth routes.

(4) The final modal split figures (Table A1.2) were calculated for each route in terms of average one-way flows. In some cases there were major differences between the two directions (see, for example, rail travel on the Kuala Lumpur-Singapore and Ipoh-Georgetown/Butterworth routes). This raised the question of whether the modal split should be calculated for each of the two directions on a particular route. The data available here, however, did not warrant this step.

Despite these difficulties the estimates of modal split given do seem to be the first ones made for Malaya. They provide, therefore, a starting point for criticism and

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1. The origin-destination zones were not comparable between the two traffic surveys. There is no evidence to suggest that either of these sets of zones correspond to the catchment areas served by air, bus or rail.
2. Note the role played by these modes on the Kuala Lumpur-Ipoh (142 miles) and Kuala Lumpur-Melaka (94 miles) routes.

reworking and a stimulus for the collection of more reliable, more up to date and more comprehensive data.

TABLE A1.1 Passenger Travel in Malaya: April 1970

Route	Air	Bus	Car[a]	Car[b]	Motorcycle[b]	Rail[c]	Taxi[a]	Taxi[b]
Kuala Lumpur-Singapore	10608	621	-	-	-	8322	-	-
Singapore-Kuala Lumpur	10891	537	4327	-	-	5967	121	-
Kuala Lumpur-Ipoh	737	820	-	17627	695	4221	-	12541
Ipoh-Kuala Lumpur	754	575	19878	15921	442	4434	14674	11909
Kuala Lumpur-Georgetown/Butterworth[f]	2397	516	-	3127	126	7967	-	411
Georgetown/Butterworth[f]-Kuala Lumpur	2017	601	5386	3886	-	8342	817	253
Ipoh-Georgetown/Butterworth[f]	532	1549	-	-	-	1338	-	-
Georgetown/Butterworth[f]-Ipoh	575	1413	-	-	-	2635	-	-
Singapore-Georgetown/Butterworth[f]	2056	-[d]	696	95	-	783	-	158
Georgetown/Butterworth[f]-Singapore	2561	-[d]	877	316	-	1264	-	-
Kuala Lumpur-Melaka	154	3415	-	-	-	-(501)[e]	-	-
Melaka-Kuala Lumpur	264	3266	14916	-	-	6(421)[e]	15612	-

a. Data were taken from the Malaysian Highway Feasibility Study (Interim Report). The survey was undertaken by Valentine, Laurie and Davies during August 1970. Survey counts were taken to represent average 24 hour totals and these were expanded to provide a total for the month of August. Deflation by a factor of 0.976 gave an estimate for April 1970.

b. A survey was conducted by the Yunit Peranchang Jalan (Highway Planning Unit) at Tanjong Malim in September 1969. Figures from 16 hour counts (6.00 a.m. to 10.00 p.m.) were taken to represent 95 percent of the full 24 hour total. Weighting the expanded total for the month by 1.377 provided the estimate for April.

c. Data include passengers on both train and rapid train (railcar) services.

d. As there is no direct bus service on this route, passengers making the full journey by bus would be included in the Singapore-Kuala Lumpur and Kuala Lumpur-Georgetown/Butterworth totals.

e. Figures in brackets refer to Kuala Lumpur-Tampin and Tampin-Kuala Lumpur movements.

f. Although they are physically separated by Penang Harbour, Georgetown and Butterworth have been taken as a single unit in this analysis because:
   (1) they are linked by an efficient passenger and vehicular "mass transit" ferry service
   (2) Butterworth acts as the rail and bus terminal for Georgetown
   (3) Bayan Lepas (on Penang Island) provides air services for both Georgetown and Butterworth.

TABLE A1.2 Modal Split for Passenger Travel in Malaya: April 1970

Route	Air	Bus	Car	Motorcycle	Rail	Taxi	Total	Estimated Total Number of Travellers in April 1970
				percent[a]				
Kuala Lumpur-Singapore[b]	47	2.5	19	-	31	0.5	100.0	22,921
Kuala Lumpur-Ipoh	2	2	48	1	12	35	100.0	37,190
Kuala Lumpur-Georgetown/Butterworth	14	4	26	1	52	3	100.0	15,674
Ipoh-Georgetown/Butterworth[b,c,d]	14	37	-	-	49	-	100.0	4,022[b,c,d]
Singapore-Georgetown/Butterworth[b,e]	58	-	12	-	26	3	100.0	3,987[b,e]
Kuala Lumpur-Melaka[b]	1	9	44	-	*	46	100.0	34,084[b]

a. Percentages were calculated on the basis of average one-way flows.
b. No data available for travel by motorcycle.
c. No data available for travel by car.
d. No data available for travel by taxi.
e. No data available for travel by bus.

- No data
* Negligible

Appendix 2: In-transit Survey

Appendix 2a : In-transit Survey Questionnaires

1. Car Travel Survey
2. Railway Travel Survey

Appendix 2b : In-transit Survey : Administration

PENYELIDEKAN PERJALANAN DENGAN KERETA: KAPADA SEMUA YANG MENGGUNAKAN KERETA

Tuan/Puan dengan hormat,

Pernah-kah TUAN/PUAN di-tanya tentang kemudahan2 apa-kah yang tuan kehendaki bagi perjalanan dengan kereta? Ini-lah peluang tuan/puan. Untok mengetahui dengan tepat tentang apa2 yang di-kehendaki oleh orang2 yang menggunakan kereta, maka saya mengadakan penyelidekan ini dengan bantuan Kementarian Pengangkutan dan Kementarian Kerjaraya, Pos dan Talikom. Hasil penerangan yang di-terima dari penyelidekan ini akan di-gunakan untok menolong menyelanggarakan kemudahan2 yang perlu bagi pemandu2 kereta. Saya akan berbesar hati sa-kira-nya tuan/puan sudi mengisi borang pertanyaan yang berikut ini pada waktu lapang tuan (kebanyakan orang mengambil hanya kira2 3 atau 4 minit untok mengisi-nya) dan kemudian memulangkan-nya kapada saya. Gunakan-lah sampul surat yang di-sediakan bersama2 pertanyaan ini. Setem untok sampul surat tersebut telah pun di-bayar dan tuan/puan tidak di-kehendaki melekatkan apa2 setem pun. Semua keterangan yang tuan/puan berikan akan di-rahasia-kan: nama tuan/puan tidak akan di-masokkan ka-dalam borang yang lengkap. Peringatan: Semua pertanyaan tentang "perjalanan ini" atau "perjalanan ini dengan kereta bermaksud perjalanan yang tuan lakukan pada waktu tuan/puan menerima borang pertanyaan ini. Walau pun tuan/puan jarang pergi ka-mana2 dengan kereta, atau pun tuan/puan tidak tinggal di-daerah ini, namun jawapan2 tuan sangat-lah penting bagi penyelidekan ini.

Terimakaseh,

D.C. Johnston

調查乘車旅行

****

致給所有駕駛汽車人士

諸位先生／女士：

您曾否被問及有關您需要那一種行車便利嗎？現在就是您的好機會。爲了明瞭駕車人士的眞正需求，本人便在交通部和工程郵電部的協助下，進行了這個調查工作。調查所得的資料，將可協助提供更能滿足駕駛者要求的便利。如果您能抽空塡妥以下的問題（大部份人士只費三四分鐘），然後用附上的信封（郵費已付，不必貼郵票）寄回給本人，本人將感激不盡。您在表格上所提供的任何資料，都將獲得嚴密的保存，而您的名字也將不會出現在已塡妥的表格上。在回答有關'這個行程'或'這個乘車的旅程'的問題時，請留意，那是指當您接到這張表格時所經歷過的旅程。即使您不是經常乘車，或者您不是這地區的居民。可是您供給的答案，對這個調查來說還是重要的。

謝謝！

D.C. Johnston

CAR TRAVEL SURVEY: TO ALL MOTORISTS

Dear Sir/Madam,

Have YOU ever been asked what kind of motoring facilities you want? This is your chance. To find out exactly what motorists want I am carrying out this survey with the assistance of the Ministry of Transport and the Ministry of Works, Posts and Telecommunications. The information gained from this survey will be used to help provide the kind of facilities that motorists require. I would be very grateful if you would complete the following questionnaire (most people take only 3 or 4 minutes) and return it to me by means of the pre-paid envelope provided. Any information that you give on the questionnaire will be held in strict confidence: your name will NOT appear on the completed form. Please note that all questions about "this journey" or "this trip by car" refer to the journey you were making when you received this questionnaire. Even if you do not often travel by car or if you do not live in this area your answers will still be important for this survey.

Thank you,

D.C. Johnston

CAR TRAVEL SURVEY: TO ALL MOTORISTS

Section A, ABOUT THIS JOURNEY BY CAR.

1. What was the date of your journey? ..../......../ 1970

2. At what time did this journey by car begin? .... a.m. p.m.

3. In what town or kampong did this journey by car begin?

   Place: .... State: ....

4. In what town or kampong will this journey by car end?

   Place: .... State: ....

5. Do you know if there are any other ways of travelling between those two places? If you do, put a cross (X) in the correct boxes.

   Aeroplane [ ] Bus [ ] Taxi [ ] Motorcycle or Scooter [ ] Railcar [ ]

   Train [ ] Coastal Ship [ ] Other (Please write down) ....

6. Please name any other main towns that you will pass through during this journey.

   ....

7. Please ESTIMATE the time your trip by car will take; the distance it will cover; and the cost of travelling by car.

   TIME ....Hours ....Minutes

   DISTANCE ....Miles

   COST ....Dollars ....Cents

8. Please say who owns the car you are driving.

   Myself [ ] A Friend or Relative [ ] My Company [ ] The Government [ ]

   Other (Please write down) ....

9. Please give the number of passengers in the car (do NOT count the driver).

   Children (Under 15 years) [ ] Adults [ ]

10. For what reason (or reasons) are you making this trip? Please put a cross in the correct box or boxes.

    To Work [ ] For Business [ ] For a Religious Event [ ] For Shopping [ ]

    To Study [ ] For a Conference or Meeting [ ] For a Family Event [ ]

    To Visit Friends [ ] On Holiday [ ] For Sport [ ] Other ....

11. What other methods of transport could YOU have used for this trip?

    Motorcycle or Scooter [ ] Train [ ] Railcar [ ] Coastal Ship [ ]

    Taxi [ ] Bus [ ] Aeroplane [ ] No Other Possible Method [ ]

    Other (Please write down) ....

12. We are interested in the reasons why you chose to travel by car rather than some other method of transport. Please give the three main reasons why you chose car in order of importance: 1, 2, 3.

    1. ....
    2. ....
    3. ....

PLEASE TURN OVER.

13. If this trip by car is only <u>part of a longer journey</u> please give the origin and destination of that longer journey. Give the name of the town, kampong or country district and State in each case.

ORIGIN: Place .... State ....

DESTINATION: Place .... State ....

14. We would like to know how satisfied you are with facilities for driving. Please write down the three main disadvantages of travelling by car, in order of importance; 1, 2, 3.

1. ....

2. ....

3. ....

Section B. ABOUT THE MOTORIST. It will help this survey to know a little about you personally; i.e. your age group, whether you own a car and so on. Please put a cross (X) in the correct boxes.

1. What is your age group?
1-19 [ ] 20-29 [ ] 30-39 [ ] 40-49 [ ] 50-59 [ ] 60- [ ]

2. What is your sex? Female [ ] Male [ ]

3. Please describe your present occupation as fully as possible (use 3 - 4 words). If you are unemployed at present, retired, a student or a housewife please write that down.
OCCUPATION. ....

4. What community do you belong to?
Malay [ ] Chinese [ ] Indian [ ] Eurasian [ ] Other Malaysian [ ]
European [ ] Other (Please write down) ....

5. Please give the number of children and adults in your household.
Children (Under 15 years) [ ] Adults [ ]

6. Please estimate the total monthly income of your household.
\$1 - \$150 [ ] \$151 - \$300 [ ] \$301 - \$500 [ ] \$501 - \$750 [ ]
\$751 - \$1000 [ ] \$1001 - \$1500 [ ] \$1501 - [ ] Don't Know [ ]

7. How many times have you travelled long distances (i.e. <u>between</u> towns) by the following methods of transport. Please put crosses in the correct boxes.

	Never	1 - 2	3,4 or 5	6 - 10	11 - 20	21 - 50	Over 50
Car							
Aeroplane							
Bus							
Taxi							
Train							

8. Do you own or have the regular use of:
Car [ ] Lorry or Van [ ] Motorcycle or Scooter [ ] Bicycle [ ]

9. Please give the town, kampong or country district and State of your normal home address.
Place: .... State: ....

THANK YOU FOR YOUR ASSISTANCE. PLEASE PLACE THE COMPLETED QUESTIONNAIRE IN THE ENVELOPE PROVIDED AND POST IT TO THE ADDRESS GIVEN.
<u>POSTAGE HAS ALREADY BEEN PAID</u>

PENYELIDEKAN TENTANG PERJALANAN DENGAN KERETAPI: KAPADA SEMUA PENUMPANG KERETAPI

Tuan/puan dengan hormat,

Pernah-kah TUAN/PUAN di-tanya jenis pengangkutan yang bagai-mana-kah yang tuan/puan kehendaki? Inilah peluang tuan/puan. Untok mengetahui dengan tepat-nya apa2 yang di-kehendaki oleh para penumpang, maka penyelidekan ini saya lakukan dengan kerjasama Keretapi Tanah Melayu. Keterangan yang di-peroleh dari penyelidekan ini akan menolong pihak Jabatan Keretapi bagi menyediakan jenis perkhidmatan yang di-kehendaki oleh para penumpang. Saya akan berbesar hati sa-kira-nya tuan/puan sudi mengisi borang pertanyaan yang berikut ini pada waktu lapang tuan (kebanyakan orang mengambil hanya kira2 3 atau 4 minit untok mengisi-nya) dan kemudian memulangkan-nya kapada saya. Gunakan-lah sampul surat yang di-sediakan bersama2 pertanyaan ini. Setem untok sampul surat tersebut telah pun di-bayar dan tuan/puan tidak di-kehendaki melekatkan apa2 setem pun. Semua keterangan yang tuan/puan beri-kan akan di-rahasiakan: nama tuan/puan TIDAK akan di-masokkan ka-dalam borang yang lengkap. Peringatan: Semua pertanyaan tentang "perjalanan ini" atau "perjalanan ini dengan keretapi" bermaksud perjalanan yang tuan/puan lakukan pada waktu tuan/puan menerima borang pertanyaan ini. Walau pun tuan/puan jarang naik keretapi, atau pun tuan/puan tidak tinggal di-daerah ini, namun jawapan2 tuan/puan sangat-lah penting bagi penyelidekan ini.

Terimakaseh,

D.C. Johnston.

調 查 乘 火 車 旅 行

致給所有搭客

諸位先生／女士：

您曾否被人問及有關您需要那一種交通服務嗎？現在就是您的好機會！爲了明瞭乘客們的眞正需求，本人便在馬來亞鐵道局的協助下進行了這個調查工作。調查所得的資料，將可協助鐵道當局改善他們的交通服務，以滿足搭客們的要求。如果您能抽空塡妥以下的問題（大部份人士只費三四分鐘），然後用附上的信封（郵費已付，不必貼郵票）寄回給本人，本人將感激不盡。您在表格上所提供的任何資料，將會獲得嚴密的保存，而您的名字也將不會出現在已塡妥的表格上。在回答有關'這個旅程'或'這個乘火車的旅程'的問題時，請留意，那是當您接到這張表格時所經歷過的旅程。即使您不是經常乘搭火車，或者您不是這地區的居民，可是您的答案，對這個調查來說還是重要的。

謝 謝

D.C. Johnston.

RAILWAY TRAVEL SURVEY: TO ALL PASSENGERS

Dear Sir/Madam,

Have YOU ever been asked what kind of transport services you want? This is your chance. To find out exactly what passengers want I am carrying out this survey with the assistance of Malayan Railways. The information gained from this survey will help the Railways to provide the kind of services that passengers require. I would be very grateful if you would complete the following questionnaire at your leisure (most people take only 3 or 4 minutes) and return it to me by means of the pre-paid envelope provided. Any information that you give on the questionnaire will be held in strict confidence: your name will NOT appear on the completed form. Please note that all questions about "this trip" or "this journey by rail" refer to the journey you were making when you received this questionnaire. Even if you do not often travel by rail or if you do not live in this area your answers will still be important for this survey.

Thank you,

D.C. Johnston.

RAILWAY TRAVEL SURVEY: TO ALL PASSENGERS

Section A. YOUR JOURNEY ON THIS TRAIN OR RAILCAR.

1. What was the date of your journey? ..../......../ 1970

2. At what time did your journey by rail begin? ...... a.m. p.m.

3. What departure time would you have preferred? ...... a.m. p.m.

4. In what town did your trip by rail begin? ....

5. In what town will your trip by rail end? ....

6. Do you know if there are any other ways of travelling between those two places? If you do, put a cross (X) in the correct box.

Aeroplane ☐ Bus ☐ Taxi ☐ Private Car ☐ Coastal Ship ☐

Motorcycle or Scooter ☐ Other (Please write down)............................

7. Please ESTIMATE the time your rail trip will take; the distance it will cover; and the cost of the fare.

TIME .....Hours ......Minutes

DISTANCE ....Miles

COST .....Dollars ......Cents

8. For what reason (or reasons) are you making this trip. Please put a cross in the correct box or boxes.

To Work ☐ For Business ☐ For a Religious Event ☐

To Study ☐ For a Conference or Meeting ☐ To Visit Friends ☐

For a Family Event ☐ On Holiday ☐ For Shopping ☐ For Sport ☐

Other (Please write down) ....

9. Who paid for this trip by rail?

Myself ☐ My Company ☐ The Government ☐ Other ....

10. By what class are you travelling?

Railcar ☐ First Class ☐ First Class Sleeper ☐ Second Class ☐

Second Class Sleeper ☐ Third Class ☐ Third Class Sleeperette ☐

11. What other methods of transport could YOU have used for this trip?

Motorcycle or Scooter ☐ Private Car ☐ Coastal Ship ☐

Taxi ☐ Bus ☐ Aeroplane ☐ No Other Possible Method ☐

Other (Please write down) ....

12. We are interested in the reasons why you chose to travel by rail rather than some other method of transport. Please give the three main reasons why you chose rail in order of importance; 1, 2, 3.

1. ....

2. ....

3. ....

13. If this trip by rail is only part of a longer journey please give the origin and destination of the longer journey. Give the name of the town, kampong or country district and State in each case.

ORIGIN: Place .... State ....

DESTINATION: Place .... State ....

PLEASE TURN OVER

14. We would like to know how satisfied you are with this rail service. Please write down the three main disadvantages of travelling by rail in order of importance; 1, 2, 3.

1. ....
2. ....
3. ....

15. Please say how many people are travelling with you.

Travelling Alone [ ] Travelling with Wife or Husband [ ]

With [ ] (give number) Children under 15 years. With [ ] (give number) Adults.

Section B. ABOUT THE PASSENGER. It will help this survey to know a little about you personally; i.e. your age group, whether you own a car and so on. Please put a cross in the correct boxes.

1. What is your age group?

1-19 [ ] 20-29 [ ] 30-39 [ ] 40-49 [ ] 50-59 [ ] 60- [ ]

2. What is your sex? Female [ ] Male [ ]

3. Please describe your present occupation as fully as possible (use 3 - 4 words). If you are unemployed at present, retired, a student or a housewife please write that down.

OCCUPATION: ....

4. What community do you belong to?

Malay [ ] Chinese [ ] Indian [ ] Eurasian [ ] Other Malaysian [ ]

European [ ] Other (Please write down) ....

5. Please give the number of Children and Adults in your Household.

Children (Under 15 years) [ ] Adults [ ]

6. Please estimate the total monthly income of your household.

$1 - $150 [ ] $151 - $300 [ ] $301 - $500 [ ] $501 - $750 [ ]

$751 -$1000 [ ] $1001 - $1500 [ ] $1501 - [ ] Don't Know [ ]

7. How many times have you travelled long distances (i.e. between towns) by each of the following methods of transport. Please put crosses in the correct boxes.

	Never	1 - 2	3, 4 or 5	6 - 10	11 - 20	21 - 50	Over 50
Railcar							
Train							
Bus							
Aeroplane							
Car							
Taxi							

8. Do you own or have the regular use of:

Car [ ] Lorry or Van [ ] Motorcycle or Scooter [ ] Bicycle [ ]

9. Please give the town, kampong or country district and State of your normal home address.

Place: .... State: ....

THANK YOU FOR YOUR ASSISTANCE. PLEASE PLACE THE QUESTIONNAIRE IN THE ENVELOPE PROVIDED AND POST IT TO THE ADDRESS GIVEN.
POSTAGE HAS ALREADY BEEN PAID

Appendix 2b: In-transit Survey : Administration

This appendix gives details of questionnaire distribution for each of the modes surveyed. Survey dates and response rates are presented in Table A2.1.

Aeroplane

The assistance of Malaysia-Singapore Airlines was sought so that questionnaires could be distributed to domestic passengers by cabin crew while in-flight or by ground staff in the departure lounge.[1] This assistance was not obtained and so it was fortunate that the Malaysian Department of Civil Aviation granted permission for questionnaires to be distributed by airport staff to passengers at Subang International Airport, Kuala Lumpur.[2] Personal observation, on occasions when a survey was "in progress", showed that the check-in and information counter staff deputed to distribute questionnaires were often too busy to do so and in some cases the questionnaires were simply left on the counters for passengers to pick up of their own accord. For these reasons the air survey was probably the least satisfactory, in physical distribution terms, of all the In-transit Surveys yet it did achieve the best response rate.

Bus

Arrangements were made to have questionnaires distributed by ticketing staff at the Jalan Pudu Bus Terminal, Kuala

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1. On October 1, 1972 Malaysia-Singapore Airlines split into Malaysian Air System and Singapore International Airlines.
2. Mr C.H. Moreira, Director of Civil Aviation kindly made this possible and also allowed me access to manuscript data on passenger movements by air.

TABLE A2.1 In-transit Survey: Administration and Response

Mode	Survey Location	Survey Dates (1970)	Number of Questionnaires Distributed	Returned		Usable[a]	
					%		%
Aeroplane	Kuala Lumpur	21-22 July	294	26	8.8	21	7.1
	Kuala Lumpur	15-16 September	343	15	4.4	13	3.8
	Kuala Lumpur	5-11 October	605	98	16.2	71	11.7
	Kuala Lumpur	2-8 November	225	8	3.6	5	2.2
	All Aeroplane Surveys		1,467	147	10.0	110	7.5
Bus	Kuala Lumpur[b]	7-13 September	87	6	6.9	4	4.6
	Kuala Lumpur[c]	14-20 September	214	48	22.4	42	19.6
	Kuala Lumpur[b]	5-11 October	68	1	1.5	1	1.5
	Kuala Lumpur[c]	5-11 October	236	30	12.7	21	8.9
	Kuala Lumpur[b]	23-29 November	367	32	8.7	28	7.6
	All Bus Surveys		972	117	12.0	96	9.9
Car	Selim River	28-29 April	1,250	93	7.4	39	3.1
	Penang Ferry	5-6 May	1,000	137	13.7	28	2.8
	Selim River	16-17 June	1,500	125	8.3	61	4.1
	Johor Baharu	30 June	490	42	8.6	2	0.4
	Selim River	20 October	1,000	83	8.3	33	3.3
	All Car Surveys		5,240	480	9.2	163	3.1
Motorcycle	Selim River	20 October	500	33	6.6	3	0.6
Taxi	Selim River	20 October	500	15	3.0	4	0.8
	Kuala Lumpur[d]	17 November	490	29	5.9	9	1.8
	All Taxi Surveys		990	44	4.4	13	1.3
Train	Kuala Lumpur[e]	6-8 July	1,000	96	9.6	48	4.8
	Kuala Lumpur[e]	14-16 September	1,000	100	10.0	35	3.5
	Kuala Lumpur[e]	26-28 October	1,079	92	8.5	31	2.9
	All Train Surveys		3,079	288	9.4	114	3.7
	TOTAL ALL SURVEYS		12,248	1,109	9.1	499	4.1

a. Questionnaires were considered usable if:
(i) they recorded "inter-city" journeys
and (ii) the questions dealing with the choice context and mode-choice reasons received meaningful responses.
Percentages are calculated from the total number of questionnaires distributed for a particular survey.

b. These surveys were conducted from the Jalan Pudu Bus Terminal in Kuala Lumpur and affected passengers travelling south to Singapore or north to Ipoh and Butterworth.

c. These surveys were carried out at the MARA building, Ipoh Road, Kuala Lumpur for passengers travelling to Kota Baharu.

d. Taxi passengers were given questionnaires as they left the Jalan Mountbatten Taxi terminal on journeys to Johor Baharu in the south or Ipoh and Butterworth in the north.

e. Questionnaires were distributed to passengers on selected trains heading:
(i) south from Butterworth
(ii) north and south from Kuala Lumpur
(iii) north from Singapore
Similar arrangements were used for the pilot survey conducted in January 1969. Five hundred questionnaires were distributed and 66 (13.2 percent) were returned.

Lumpur (for long distance services to Singapore and to Ipoh or Butterworth) and at the MARA building, Ipoh Road, Kuala Lumpur (for the service to Kota Baharu).[1] This procedure proved only partly successful at the Jalan Pudu Terminal and so the third survey there was conducted by personally handing questionnaires to passengers on buses bound for Singapore or Ipoh and Butterworth, in the last few minutes before departure.

Car

Persons making journeys by private car are normally inaccessible to the researcher.[2] In Malaya, however, there are a number of highway toll-houses where all vehicles using a particular route must stop (though momentarily) and so these provide one possible point of contact with motorists. Two of these "toll-houses" were used for this study: (a) the Selim River Toll House on the main Kuala Lumpur to Ipoh highway, 72 miles north of Kuala Lumpur and (b) the ticket booths at Pengkalan Raja Tun Uda in Georgetown where motorists pay the ferry charges before driving aboard the passenger-vehicular ferry plying across Penang Harbour

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1. Grateful thanks are due to Mr Loo Eng Kee, Law and Company and Inche Mohammed Razali bin Haji Bidin, Director of Transport, MARA (as well as their respective staffs) for permission to carry out, and assistance with, these surveys.
2. Origin-destination travel surveys in Malaysia have been conducted using brief interviews at police-controlled road blocks (see, for example Yunit Peranchang Jalan 1969 and 1970). These resources were not available to the present study, however.

between Georgetown and Butterworth.[1] One survey was conducted at the latter location. Motorists were handed questionnaires as they passed through the ticket booths and were asked to complete them during the 15 minute ferry crossing so that they could be collected as cars left the Malaysian Customs station at Butterworth. Three separate surveys were conducted at the Selim River Toll House and on each occasion motorists were given a copy of the questionnaire which included a reply-paid envelope for easy return of the completed form.

One additional survey was conducted from the Malaysian Customs station, Johor Baharu, in an attempt to gain some information on car travel between Singapore and Kuala Lumpur. Motorists were given a copy of the In-transit Survey questionnaire as they drove out of the vehicle checking hall (after having crossed the Causeway from Singapore).[2]

Motorcycle

A single survey of motorcyclists was undertaken at the Selim River Toll House. The questionnaire was worded specifically for motorcyclists but otherwise the distribution procedure was the same as for motorists.

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1. Mr Inder Singh Khosa, Assistant Secretary, Ministry of Works, Posts and Telecommunications gave permission for the Car, Motorcycle and Taxi surveys to be carried out at the Selim River Toll House. I am indebted to him and to the staff of the Toll House.

   Permission to have questionnaires distributed by Penang Port Commission staff was granted by Mr Lim Teik Chuan, Management Services Manager, Penang Port Commission. Mr Khaw Cheng Joey, Ferry Manager, arranged the physical distribution of the questionnaires through the ferry ticket booths.

2. Permission to conduct this survey from within the precincts of the Customs station was granted by Encik Nik Mahmood bin Nik Yaacob, Administration Officer, Customs Headquarters.

Taxi

The Selim River Toll House was also used for one taxi survey. Each passenger in every "long distance" taxi that passed through the Toll House was given a questionnaire.[1] A second survey of taxi passengers was carried out at the Jalan Mountbatten depot in Kuala Lumpur for long distance taxis. As each taxi destined for Johor Baharu, Ipoh or Georgetown left the depot the passengers were given a copy of the taxi travel questionnaire.[2]

Train

The General Manager of Malayan Railways gave permission for railway guards to distribute questionnaires to passengers on express ("inter-city") services departing from Kuala Lumpur, Singapore and Butterworth.[3] Three separate surveys were conducted among train passengers.

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1. The potential level of response from this survey was reduced by the many taxi drivers who insisted on having a copy of the questionnaire for themselves.
2. I am most grateful to Encik Mokhtar bin Marji, Superintendent of Car Parks, Federal Capital of Kuala Lumpur for permission to carry out this survey at the Jalan Mountbatten depot. There was, of course, no assurance that a passenger in a taxi bound for a particular city did in fact end his journey at that city.
3. I am deeply indebted to Encik Waad bin Jamaluddin, General Manager, Malayan Railway Administration for permission to carry out this survey and to many members of his staff for their assistance with it.

Appendix 3: Mode Image Survey

Appendix 3a : Mode Image Questionnaire

Appendix 3b : Mode Image Survey : Administration

STUDIES OF PASSENGER TRANSPORTATION

Different people have different ideas about methods of transport. This study is designed to find out what certain methods of transport mean to YOU. On the next few pages you will find a number of diagrams like the one below. Each diagram is headed by two words (or phrases) with opposite meanings. Below the headings are several lines of boxes - one line of boxes for each of the seven main methods of passenger transport. Your task is to judge each method of transport on the idea given by the heading. You do this by putting a cross (X) in one box in each row to show how that method compares with that idea. The following examples show how one person judged several methods of transport on the idea FAST-SLOW.

		FAST						SLOW	
(A)	Walking	3	2	1	0	1	2	~~3~~	4
(B)	Bicycle	3	2	1	0	1	~~2~~	3	4
(C)	Aeroplane	~~3~~	2	1	0	1	2	3	4
(D)	Ship	3	2	~~1~~	0	1	2	3	4

In example (A) the person thought that Walking was a very slow method of transport so he put a cross in box 3 towards SLOW. In (B) he thought that a Bicycle was also a slow way of travelling but not as slow as Walking - he thought that it was quite slow so he put a cross in box 2 towards SLOW. In (C) he put a cross in box 3 towards FAST as he believed that an Aeroplane was a very fast way of travelling. This person also thought that a Ship was slightly fast so he put a cross in box 1 towards FAST.

You can think of the boxes towards the FAST end to mean: 1 - slightly fast; 2 - quite fast; and 3 - very fast. In the same way you can think of the boxes towards the SLOW end to mean: 1 - slightly slow; 2 - quite slow; and 3 - very slow. A cross in box 0 would show that a certain method was exactly half way between FAST and SLOW.

Sometimes the idea might seem to have no meaning for that particular method of transport. In this case you should put a cross in box 4. In example (E) the person thought that the idea HELPFUL STAFF - STAFF NOT HELPFUL had no meaning for Walking so he put a cross in box 4.

		HELPFUL STAFF						STAFF NOT HELPFUL	
(E)	Walking	3	2	1	0	1	2	3	~~4~~

The following examples are for you to practise on. The idea you must judge for each method of transport is COMFORTABLE - UNCOMFORTABLE.

	COMFORTABLE						UNCOMFORTABLE	
Ocean Liner	3	2	1	0	1	2	3	4
Bicycle	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4

In this study you will be judging the following methods of transport according to your ideas about them for long distance travel (i.e. Kuala Lumpur to Penang; or Kuala Lumpur to Singapore): Aeroplane, Bus, Motorcycle, Private Car, Railcar, Taxi and Train. This is NOT an examination but it is important that we obtain YOUR OWN ideas about these methods of transport. Please make sure that you put one cross for each method in each diagram.

2.

	INCONVENIENT DEPARTURE TIMES						CONVENIENT DEPARTURE TIMES	
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4

	CLEAN						DIRTY	
Taxi	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4

	CAN SEE SCENERY						CANNOT SEE SCENERY	
Bus	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4

PLEASE TURN OVER

3.

	RESTRICTED TO ONE ROUTE						CAN GO ANYWHERE	
Bus	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4

	FAST						SLOW	
Taxi	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4

	PLENTY OF SPACE						CRAMPED	
Aeroplane	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4

PLEASE TURN OVER

4.

	RELAXING						TIRING	
Aeroplane	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4

	HIGH SOCIAL STATUS						LOW SOCIAL STATUS	
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4

	NOISY						QUIET	
Taxi	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4

PLEASE TURN OVER

5.

	NEVER ON TIME						ALWAYS ON TIME	
Bus	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	11	2	3	4
Train	3	2	1	0	1	2	3	4

	CROWDED						NOT CROWDED	
Bus	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4

	UNCOMFORTABLE SEATS						COMFORTABLE SEATS	
Taxi	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4

PLEASE TURN OVER

6.

	DIFFICULT TO TAKE LUGGAGE						EASY TO TAKE LUGGAGE	
Aeroplane	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4

	HOT						COLD	
Aeroplane	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4

	ROUGH RIDE						SMOOTH RIDE	
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4

PLEASE TURN OVER

7.

	MUCH WAITING						NO WAITING	
Train	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4

	EASILY ACCESSIBLE						ACCESS IS DIFFICULT	
Bus	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4

	CONVENIENT						INCONVENIENT	
Bus	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4

PLEASE TURN OVER

8.

	DANGEROUS					SAFE		
Taxi	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Aeroplane	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4

	SHORT TRAVEL TIME					LONG TRAVEL TIME		
Aeroplane	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4

	EXPENSIVE					CHEAP		
Aeroplane	3	2	1	0	1	2	3	4
Motorcycle	3	2	1	0	1	2	3	4
Railcar	3	2	1	0	1	2	3	4
Train	3	2	1	0	1	2	3	4
Taxi	3	2	1	0	1	2	3	4
Private Car	3	2	1	0	1	2	3	4
Bus	3	2	1	0	1	2	3	4

PLEASE TURN OVER

9.

Imagine that you have to make a business trip to Singapore. You would probably think about different methods of transport for the journey and the choose the one with the qualities that you wanted. Please show how important each of the following qualities would be in YOUR decision by putting a number in each box.

1 - Very Important
2 - Quite Important
3 - Neither Important nor Unimportant
4 - Quite Unimportant
5 - Very Unimportant

The CONVENIENCE OF THE DEPARTURE TIMES [ ]

Ability to SEE THE SCENERY [ ]

The SPEED of the method [ ]

The SOCIAL STATUS of the method [ ]

The PUNCTUALITY of the method [ ]

How COMFORTABLE THE SEATS are [ ]

How HOT it is when travelling [ ]

The amount of WAITING [ ]

The CONVENIENCE of the method [ ]

The COST of the method [ ]

How CLEAN it is [ ]

Ability to GO ANYWHERE [ ]

The AMOUNT OF SPACE in the vehicle [ ]

How NOISY it is [ ]

How CROWDED it is [ ]

The ease of TAKING LUGGAGE [ ]

The SMOOTHNESS of the ride [ ]

The ease of ACCESS to the method [ ]

The amount of TRAVEL TIME [ ]

There are, of course, a very large number of different qualities that you could consider during your decision - we have certainly not mentioned them all here. Are there any other qualities that you think would be important in YOUR choice? If there are please write them down.

....

....

....

Please imagine again that you have to make a business trip to Singapore. **Rank the following methods of transport in the order that YOU would choose them for that journey.** Put the number 1 in the box beside your first choice; the number 2 in the box beside your second choice; the number 3 for your third choice and so on until you put the number 7 for your last choice. Put a number between 1 and 7 in each box. Do not use any number twice.

Bus [ ]

Train [ ]

Private Car [ ]

Motorcycle [ ]

Taxi [ ]

Aeroplane [ ]

Railcar [ ]

PLEASE TURN OVER

10.

It will help this survey to know a little about you personally; i.e your age group, whether you own a car and so on. Please answer the following questions by putting a cross (X) in the correct boxes.

1. What is your age group?
1-19 [ ]   20-29 [ ]   30-39 [ ]   40-49 [ ]   50-59 [ ]   60- [ ]

2. What is your sex?   Female [ ]   Male [ ]

3. Please describe your present occupation as fully as possible (use 3 - 4 words). If you are unemployed at present, retired or a housewife please write that down. Students should write down "student" and then give their father's occupation.

OCCUPATION: ....

4. What community do you belong to?
Malay [ ]   Chinese [ ]   Indian [ ]   Eurasian [ ]   Other Malaysian [ ]
European [ ]   Other (Please write down) ....

5. Please give the total number of children and adults in your household.
Children (Under 15 years) [ ]   Adults [ ]

6. Please estimate the total monthly income of your household.
$1 - $150 [ ] $151 - $300 [ ] $301 - $500 [ ] $501 - $750 [ ]
$751 - $1000 [ ] $1001 - $1500 [ ] $1501 - [ ]   Don't Know [ ]

7. How many times in the last 5 years have you travelled long distances (i.e. between towns) by each of the following methods of transport. Please put crosses in the correct boxes.

	Never	1 - 2	3,4 or 5	6 - 10	11 - 20	21 - 50	Over 50
Aeroplane							
Bus							
Motorcycle							
Private Car							
Railcar							
Taxi							
Train							

8. How many times in the last 12 months have you travelled to the following places? What method of transport did you use most often for the journeys to each place?

	Never	1 - 2	3,4 or 5	6 - 10	11 - 20	21 - 50	Over 50	Usual Method of Transport
Penang								
Ipoh								
Kuantan								
Kota Bharu								
Singapore								

9. Do you own or have the regular use of:
Car [ ]   Lorry or Van [ ]   Motorcycle or Scooter [ ]   Bicycle [ ]

10. Please give the town, kampong or country district and State of your normal home address.
Place: ....   State: ....

THANK YOU FOR YOUR ASSISTANCE

Appendix 3b: Mode Image Survey : Administration

The distribution and return of the Mode Image questionnaire was organised through groups of school pupils, university students, employees in government departments or private business and certain respondents to the In-transit Survey. The administration of the questionnaire to each of these groups is described briefly. Table A3.1 sets out the distribution of responses among these various groups.

School Pupils

The youngest group of respondents to the Mode Image Survey was made up of Form Four boys at Maxwell Road School in Kuala Lumpur.[1] In this case the questionnaire was completed under "examination conditions". Pupils were given time to read through the instructions and then asked if there were any questions or problems. The only real query was raised by one boy who was unfamiliar with the word "railcar" but quickly understood the Malay equivalent "teren rengkas". Comments made by the boys after completing the questionnaire indicated that there had been no difficulties in understanding the instructions or working through the various sections and this provided some evidence that the questionnaire was clear enough to be confidently used for self-administration in other groups.

University Students

Three separate groups of university students responded

1. I am most grateful to Mr Nadarajah, Principal of Maxwell Road School for allowing me to conduct this survey in his school. Form Four pupils in Malaya are in their fourth year of secondary education and are aged 16-17.

TABLE A3.1 Mode Image Survey: Administration and Response

Response Group	Questionnaires Returned[a]	Questionnaires Analysed for Mode Image[b]	Questionnaires Analysed for Choice Model[c]
School Pupils			
Maxwell Road	69	67	65
University Students			
Universiti Kebangsaan: Geography	17	16	14
University of Malaya: Statistics	36	35	35
University of Malaya: Engineering	16	16	16
Total	69	67	65
Government Departments			
Ministry of Works	7	7	6
Road Transport Department	14	14	13
Ministry of Transport	35	28	28
Malayan Railways	35	33	31
Total	91	82	78
Private Business			
Gestetner (Eastern) Ltd	4	3	3
In-transit Survey			
Identifiable Respondents	43	38	33
TOTAL	275	257	244

a. A response-rate is meaningful only for the In-transit section of this survey: 151 were posted out and 43 returned; a response rate of 28.5 per cent.

b. Questionnaires were selected for analysis if no more than 10 of the 126 semantic differential responses (6 modes by 21 scales) had been omitted.

c. Questionnaires were omitted from the Choice Model analyses if the 6 preference rankings had not been given correctly.

to the Mode Image questionnaire. The first of these comprised first year Geography students at the Universiti Kebangsaan, Kuala Lumpur.[1] Two additional sets of responses were obtained from students at the University of Malaya also in Kuala Lumpur: (a) a class of second year students in the Statistics Department, Faculty of Economics and Administration and (b) an informal group of senior Engineering students.[2] In each case the questionnaires were distributed so that they could be completed in the students' own time and collected at a later date.

Employees of Government Departments

With the kind assistance of interested officials similar surveys were undertaken in certain government departments and quasi-government organisations. Questionnaires were distributed so that they could be completed outside office hours and were then collected at a later date. Responses were obtained from the Ministry of Works, Posts and Telecommunications (Toll House Section and Highway Planning Unit), the Road Transport Department, the Ministry of Transport and Malayan Railways.[3]

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1. I am most grateful to Encik Mohammed Sham bin Mohammed Sani for conducting this survey for me.
2. Mr Loh Hooi Tong kindly organized the distribution of questionnaires to his Statistics students. Mr Loh Sau Hua encouraged fellow Engineering students to participate in this survey.
3. I gratefully acknowledge the interest and assistance of:
   Mr Inder Singh Khosa and Mr M. Subramaniam, Ministry of Works, Posts and Telecommunications;
   Mr S.B. Ong and Mr A. Arokiasamy, Road Transport Department;
   Encik Saad bin Marzuki, Ministry of Transport;
   Mr G.R.A. Durairajah, Malayan Railways.

Employees in Private Business

Apart from one small group in the company where the questionnaires were printed, it was found that private business concerns were not interested in distributing the Mode Image questionnaire among their employees. Efforts to obtain responses from persons in business and professional occupations by contacting the major service clubs in Kuala Lumpur were also unsuccessful.

Respondents to the In-transit Survey

A number of the respondents to the In-transit Survey had given their name and address on the completed form and so these people were also sent a copy of the Mode Image questionnaire. As with the In-transit surveys, a reply-paid envelope was enclosed to facilitate return of the completed questionnaire.

Appendix 4: Profile of Survey Respondents

TABLE A4.1 Profile of Survey Respondents

Variable	In-transit Surveys		Mode Image Survey	
	Number	Percent	Number	Percent
Total Number of Respondents	499	100.0	257	100.0
Age				
1 - 19	34	6.8	71	27.6
20 - 29	184	36.9	118	45.9
30 - 39	131	26.3	30	11.7
40 - 49	86	17.2	24	9.3
50 - 59	53	10.6	9	3.5
60+	10	2.0	1	0.4
Not Stated	1	0.2	4	1.6
Sex				
Female	83	16.6	40	15.6
Male	404	81.0	213	82.9
Not Stated	12	2.4	4	1.6
Occupation[a]				
Professional and Technical	129	25.9	40	15.6
Administrative and Managerial	103	20.6	25	9.7
Clerical	60	12.0	65	25.3
Sales	29	5.8	14	5.4
Service	33	6.6	8	3.1
Agriculture, Forestry, Fishing	6	1.2	9	3.5
Production Workers and Laborers	103	20.6	29	11.3
Not Economically Employed	26	5.2	18	7.0
Not Stated	10	2.0	49	19.1

a. These categories were coded according to Dictionary of Occupational Classification: Malaysia, Department of Statistics, Malaysia, 1968.

School and university students were asked to give the occupation of their father and were tabulated accordingly.

	In-transit Survey		Mode Image Survey	
	Number	Percent	Number	Percent
Ethnic Group				
Malay	165	33.1	86	33.5
Chinese	169	33.9	111	43.2
Indian	35	7.0	49	19.1
Others	121	24.2	4	1.6
Not Stated	9	1.8	7	2.7
Income[b]				
1 - 150	30	6.0	25	9.7
151 - 300	70	14.0	50	19.5
301 - 500	59	11.8	47	18.3
501 - 750	38	7.6	22	8.6
751 - 1000	42	8.4	27	10.5
1001 - 1500	62	12.4	30	11.7
1501 -	135	27.1	12	4.7
Not Stated	63	12.6	44	17.1
Car Ownership				
Own or have regular use	368	73.7	108	42.0
Do not own or have regular use	131	26.3	149	58.0
Motorcycle Ownership				
Own or have regular use	87	17.4	70	27.2
Do not own or have regular use	412	82.6	187	72.8

b. Household income in Malaysian dollars per month

	In-transit Survey		Mode Image Survey	
	Number	Percent	Number	Percent
Travel Experience: Air				
Never travelled	64	12.8	164	63.8
1 - 2 trips	66	13.2	35	13.6
3 - 5 trips	43	8.6	8	3.1
6 - 10 trips	38	7.6	5	1.9
11 - 20 trips	32	6.4	4	1.6
21 - 50 trips	47	9.4	2	0.8
Over 50 trips	79	15.8	4	1.6
Not Stated	130	26.1	35	13.6
Travel Experience: Bus				
Never travelled	81	16.2	37	14.4
1 - 2 trips	70	14.0	35	13.6
3 - 5 trips	68	13.6	43	16.7
6 - 10 trips	38	7.6	17	6.6
11 - 20 trips	31	6.2	24	9.3
21 - 50 trips	23	4.6	11	4.3
Over 50 trips	39	7.8	62	24.1
Not Stated	149	29.9	28	10.9
Travel Experience: Car				
Never travelled	28	5.6	29	11.3
1 - 2 trips	29	5.8	23	8.9
3 - 5 trips	41	8.2	36	14.0
6 - 10 trips	36	7.2	28	10.9
11 - 20 trips	39	7.8	27	10.5
21 - 50 trips	31	6.2	24	9.3
Over 50 trips	205	41.1	66	25.7
Not Stated	90	18.0	24	9.3

	In-transit Survey		Mode Image Survey	
	Number	Percent	Number	Percent
Travel Experience: Motorcycle[c]				
Never travelled	5		108	42.0
1 - 2 trips	1		40	15.6
3 - 5 trips	-		22	8.6
6 - 10 trips	1		15	5.8
11 - 20 trips	-		9	3.5
21 - 50 trips	2		10	3.9
Over 50 trips	2		19	7.4
Not Stated	5		34	13.2
Travel Experience: Taxi				
Never travelled	63	12.6	28	10.9
1 - 2 trips	71	14.2	52	20.2
3 - 5 trips	78	15.6	42	16.3
6 - 10 trips	55	11.0	41	16.0
11 - 20 trips	34	6.8	33	12.8
21 - 50 trips	29	5.8	21	8.2
Over 50 trips	30	6.0	20	7.8
Not Stated	139	27.9	20	7.8
Travel Experience: Train				
Never travelled	29	5.8	54	21.0
1 - 2 trips	79	15.8	52	20.2
3 - 5 trips	88	17.6	48	18.7
6 - 10 trips	69	13.8	29	11.3
11 - 20 trips	56	11.2	21	8.2
21 - 50 trips	37	7.4	19	7.4
Over 50 trips	62	12.4	16	6.2
Not Stated	79	15.8	18	7.0

c. This information was collected only for the Taxi and Motorcycle sections of the In-transit Survey.

	In-transit Survey		Mode Image Survey	
	Number	Percent	Number	Percent
Total Travel Experience[d]				
Never Travelled	66	13.2	36	14.0
1 - 2 trips	20	4.0	10	3.9
3 - 5 trips	23	4.6	11	4.3
6 - 10 trips	34	6.8	20	7.8
11 - 20 trips	48	9.6	38	14.8
21 - 50 trips	56	11.2	35	9.7
Over 50 trips	252	50.5	117	45.5
Not Stated	-		-	
Questionnaire Language[e]				
Malay	133	26.7	14	5.4
Chinese	17	3.4	-	-
English	347	69.9	243	94.6
Payment of Travel Costs[f]				
Traveller	310	62.1		
Friend or Relative	20	4.0		
Traveller's Company	120	24.0		
Government or Official	46	9.2		
No Response	3	0.6		

d. Estimated by combining the reported experience categories for the six modes (Experience Not Stated was taken as No Experience).

e. A Chinese language questionnaire was not used in the Mode Image Survey.

f. For the In-transit car and motorcycle surveys this was defined by the question "Who owns the car (motorcycle) you are driving?" Comparable information was not collected by the Mode Image Survey.

	In-transit Survey		Mode Image Survey	
	Number	Percent	Number	Percent
Trip Purpose[g]				
Work/Business	228	35.2	126	49.0
Meet family or friends	146	22.5	-	
Holiday	135	20.8	131	51.0
Conference	68	10.5	-	
Shopping	18	2.8	-	
Study	17	2.6	-	
Religious Event	10	1.5	-	
Personal Business	9	1.4	-	
Sport	7	1.1	-	
Return home	6	0.9	-	
Taking Passenger	2	0.3	-	
No Response	2	0.3	-	
Route				
Kuala Lumpur - Ipoh	70	14.0	-	
Kuala Lumpur - Penang	66	13.2	108	42.0
Kuala Lumpur - Singapore	76	15.2	117	45.5
Kuala Lumpur - Alor Setar	8	1.6	-	
Kuala Lumpur - Kota Baharu	60	12.0	-	
Ipoh - Kuala Lumpur	51	10.2	4	1.6
Ipoh - Singapore	1	0.2	-	
Ipoh - Kota Baharu	1	0.2	-	
Penang - Ipoh	5	1.0	-	
Penang - Kuala Lumpur	69	13.8	6	2.3
Penang - Singapore	16	3.2	-	
Penang - Alor Setar	13	2.6	-	
Singapore - Ipoh	4	0.8	-	
Singapore - Kuala Lumpur	28	5.6	3	1.2
Singapore - Penang	7	1.4	-	
Alor Setar - Kuala Lumpur	7	1.4	1	0.4
Kota Baharu - Kuala Lumpur	16	3.2	-	
Kota Baharu - Singapore	1	0.2		
Other Places - Kuala Lumpur[h]	-		18	7.0

g. Multiple responses were accepted for the In-transit Survey.

h. The routes summarised as "Other Places - Kuala Lumpur" were generated by those respondents to the In-transit Survey who also replied to the Mode Image Survey. In these cases the journey "origin" was defined by the home location and so a number of the origins did not belong among the set of "cities" defined for this study.

Appendix 5: Computational Details

Appendix 5a : The Analysis of "Combinations"

Appendix 5b : Contingency Table Analyses

Appendix 5c : Rank Order Correlation

Appendix 5d : Attribute Importance: Ratings and Weights

Appendix 5a: The Analysis of "Combinations"

Several of the items of information derived from the In-transit Survey were collected on multiple response formats; 10 responses were accepted for both possible and practicable modes, 6 for trip purpose, 5 for mode-choice reasons and 5 for mode disadvantages. Combinations among these responses have been analysed to:

(a) investigate whether particular responses tended to be associated with each other

(b) provide a single index from the multiple responses for use in further analysis.

The following procedure was used to identify response combinations:

1) where necessary, reduce the responses to a smaller, more manageable number of general categories. The 34 different trip purposes were reduced to 14 categories, 308 mode choice reasons became 38 and 387 mode disadvantages divided into 36 groups. In the case of modes, only the 6 "inter-city" modes were used.

2) assign each general category a separate prime number. The "no response" category was given the value 1. Categories which appeared more than once for the same respondent were ignored.

3) calculate the product of the prime numbers associated with the categories reported by a particular respondent. This product is the unique identifier for each possible combination of categories.

4) As some of the products were very large one final step

was taken to simplify the use of this identifier in further analyses. Each different identifier was allocated a sequence number thereby reducing the maximum number of digits required to express the identifier from six to two. This sequence number was used to summarise the multiple responses for analyses of combinations among possible, practicable and impracticable modes, mode-choice reasons, mode disadvantages and trip purposes.

Appendix 5b: Contingency Table Analyses

This appendix presents the detailed tables referenced during discussion of the variables found to be most important in differentiating the choice context or the mode descriptors. Each table is in three parts:

1) observed frequencies obtained directly from tabulations of the survey data
2) expected frequencies calculated according to the hypothesis of no relationship between the two variables:

$$E_{ij} = \frac{R_i \cdot C_j}{N}$$

where E_{ij} = expected frequency for cell i, j.
R_i = total observed frequency for row i.
C_j = total observed frequency for column j.
N = total observed frequency for the entire contingency table.

(Siegel, 1956, p.105)

3) chi-square components calculated according to the formula

$$C_{ij} = \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where C_{ij} = chi-square component for cell i, j.
O_{ij} = observed frequency in cell i, j.
E_{ij} = expected frequency in cell i, j.

Summing the chi-square components defines the value of chi-square for the contingency table. (Siegel, 1956, p.175) The largest chi-square components identify the particular cells in the contingency table that deviate most from the value expected under the null hypothesis and that contribute most strongly to the magnitude of chi-square and V^2.

Cramer's V^2 was calculated according to the formula

$$V^2 = \frac{\chi^2}{N \ \mathrm{Min}\ (r-1,\ c-1)}$$

where χ^2 (chi-square) $= \sum_{i=1}^{r} \sum_{j=1}^{c} c_{ij}$

N = total observed frequency for the entire contingency table

r = number of rows in the contingency table

c = number of columns in the contingency table

(Blalock, 1960, p.230)

TABLE A5.1 Differentiating the Choice Context: Practicable Modes and Car Ownership

Car Ownership	Aeroplane	Bus	Car	Motorcycle	Taxi	Train	Total
				Modes Cited as "Practicable"			
				observed frequencies			
Own or have regular use	260	149	293	35	199	243	1179
Do not own	58	94	42	23	85	101	403
	318	243	335	58	284	344	1582
				expected frequencies[a]			
Own or have regular use	237	181	250	43	212	256	1179
Do not own	81	62	85	15	72	88	403
	318	243	335	58	284	344	1582
				chi-square components			
Own or have regular use	2.23	5.69	7.52	1.57	0.76	0.70	
Do not own	6.53	16.64	22.01	4.58	2.21	2.04	

$\chi^2 = 72.5$ $V^2 = 0.046$

a. Rounded to the nearest whole number.

TABLE A5.2 <u>Differentiating the Choice Context: Impracticable Modes and Car Ownership</u>

Car Ownership	Aeroplane	Bus	Car	Motorcycle	Taxi	Train	Total
			Modes Viewed as "Impracticable"				
			observed frequencies				
Own or have regular use	78	159	53	175	127	90	682
Do not own	38	19	43	42	20	6	168
	116	178	96	217	147	96	850
			expected frequencies[a]				
Own or have regular use	93	143	77	174	118	77	682
Do not own	23	35	19	43	29	19	168
	116	178	96	217	147	96	850
			chi-square components				
Own or have regular use	2.4	1.8	7.5	0.0	0.7	2.2	
Do not own	9.9	7.4	30.4	0.0	2.8	8.9	

$\chi^2 = 74.1$ $\qquad V^2 = 0.087$

a. Rounded to the nearest whole number.

TABLE A5.3 Differentiating the Mode Descriptors: Mode-Choice Reasons and Survey Travel Mode

Mode-Choice Reasons	Survey Travel Mode: Aeroplane	Bus	Car	Train	Taxi/ Motorcycle[a]	Total
	observed frequencies					
Speed	42	21	26	1	10	100
Travel Time	67	37	28	8	10	150
Flexibility	1	2	126	6	7	142
Comfortable Seats	39	19	12	14	2	86
Scenery	0	10	12	17	0	39
Preference	5	5	14	16	1	41
Relaxing	20	13	8	28	2	71
Miscellaneous	29	64	77	122	9	301
Convenience	29	11	82	7	8	137
Cost	17	75	89	63	5	249
Safety	9	38	15	50	0	112
	258	295	489	332	54	1428[b]
	expected frequencies[c]					
Speed	18	21	34	23	4	100
Travel Time	27	31	51	35	6	150
Flexibility	26	29	49	33	5	142
Comfortable Seats	16	18	29	20	3	86
Scenery	7	8	13	9	1	39
Preference	7	8	14	10	2	41
Relaxing	13	15	24	17	3	71
Miscellaneous	54	62	103	70	11	301
Convenience	25	28	47	32	5	137
Cost	45	51	85	58	9	249
Safety	20	23	38	26	4	112
	258	295	489	332	54	1428
	chi-square components					
Speed	31.7	0.0	2.0	21.3	10.2	
Travel Time	58.7	1.2	10.6	20.7	3.3	
Flexibility	23.7	25.5	123.1	22.1	0.5	
Comfortable Seats	35.4	0.1	10.3	1.8	0.5	
Scenery	7.1	0.5	0.1	6.9	1.5	
Preference	0.8	1.4	0.0	4.4	0.2	
Relaxing	4.0	0.2	11.0	8.0	0.2	
Miscellaneous	11.9	0.1	6.6	38.7	0.5	
Convenience	0.7	10.6	26.2	19.4	1.5	
Cost	17.4	10.8	0.2	0.5	2.1	
Safety	6.2	9.6	14.2	22.1	4.2	

$\chi^2 = 652.3$ $V^2 = 0.114$

a. Categories were combined to meet the requirements for calculating chi-square.

b. Three "no-response" reasons have been excluded from this analysis.

c. Rounded to the nearest whole number. For this reason the cell entries do not always sum exactly to the marginal totals.

TABLE A5.4 Differentiating the Mode Descriptors: Mode-Choice Reasons and Car Ownership

Mode-Choice Reasons	Car Ownership: Own a Car or have regular use of one	Car Ownership: Do not own or have regular use of car	Total
	observed frequencies		
Speed	70	30	100
Travel Time	115	35	150
Flexibility	135	7	142
Comfortable Seats	68	18	86
Scenery	24	15	39
Preference	32	9	41
Relaxing	48	23	71
Miscellaneous	198	103	301
Convenience	117	18	135
Cost	164	83	247
Safety	61	49	110
	1032	390	1422[a]
	expected frequencies[b]		
Speed	73	27	100
Travel Time	109	41	150
Flexibility	103	39	142
Comfortable Seats	62	24	86
Scenery	28	11	39
Preference	30	11	41
Relaxing	52	19	71
Miscellaneous	218	83	301
Convenience	98	37	135
Cost	179	68	247
Safety	80	30	110
	1032	390	1422
	chi-square components		
Speed	0.1	0.2	
Travel Time	0.4	0.9	
Flexibility	9.9	26.2	
Comfortable Seats	0.5	1.3	
Scenery	0.7	1.7	
Preference	0.2	0.5	
Relaxing	0.2	0.6	
Miscellaneous	1.9	5.0	
Convenience	3.7	9.8	
Cost	1.3	3.4	
Safety	4.4	11.8	

$\chi^2 = 84.8$ $V^2 = 0.060$

a. Nine cases of "no-response" have been excluded from this analysis.

b. Rounded to the nearest whole number.

TABLE A5.5 Differentiating the Mode Descriptors: Mode Disadvantages and Survey Travel Mode

Mode Disadvantages	Survey Travel Mode					
	Aero-plane	Bus	Car	Train	Taxi/ Motorcycle[a]	Total
			observed frequencies			
Travel Time	3	11	52	64	0	130
En-route Facilities	14	55	15	59	3	146
Waiting	67	0	0	2	1	70
Access	33	1	6	2	3	45
Safety	7	17	161	0	17	202
Uncomfortable Seats	3	18	1	15	0	37
Tiring	3	3	35	6	0	47
Heat	1	31	16	15	2	65
Cleanliness	0	4	12	21	1	38
Rough Ride	7	12	39	17	1	76
Cost	17	2	17	9	3	48
Miscellaneous	63	69	75	114	14	335
	218	223	429	324	45	1239[b]
			expected frequencies[c]			
Travel Time	23	23	45	34	5	130
En-route Facilities	26	26	51	38	5	146
Waiting	12	12	24	18	3	70
Access	8	8	16	12	2	45
Safety	36	36	70	53	7	202
Comfortable Seats	7	7	13	10	1	37
Tiring	8	8	16	12	2	47
Heat	11	12	23	17	2	65
Cleanliness	7	7	13	10	1	38
Rough Ride	13	14	26	20	3	76
Cost	8	9	17	13	2	48
Miscellaneous	59	60	116	88	12	335
	218	223	429	324	45	1239
			chi-square components			
Travel Time	17.3	6.6	1.1	26.5	4.7	
En-route Facilities	5.3	31.4	25.0	11.4	1.0	
Waiting	242.8	12.6	24.2	14.5	0.9	
Access	79.5	6.2	5.9	8.1	1.1	
Safety	22.9	10.3	118.6	52.8	12.7	
Comfortable Seats	1.9	19.3	10.9	2.9	1.3	
Tiring	3.4	3.5	21.6	3.2	1.7	
Heat	9.5	31.8	1.9	0.2	0.1	
Cleanliness	6.7	1.2	0.1	12.3	0.1	
Rough Ride	3.0	0.2	6.1	0.4	1.1	
Cost	8.7	5.1	0.1	1.0	0.9	
Miscellaneous	0.3	1.3	14.5	8.0	0.3	

$\chi^2 = 928.0$ $\qquad V^2 = 0.187$

a. Categories were combined to meet the requirements for calculating chi-square.

b. Fiftyone "no-response" disadvantages have been excluded from this analysis.

c. Rounded to the nearest whole number. For this reason the cell entries do not always sum exactly to the marginal totals.

Appendix 5c: Rank Order Correlation

The Spearman rank order correlation coefficient (rho) has been used to index the degree of "fit" between the rank order predicted by a particular model and the preference order reported by each respondent. Rho is given by

$$\rho = 1.0 - \frac{6 \sum d_i^2}{N^3 - N}$$

where d_i = the difference between the predicted rank and the preference rank for the i th mode

N = the number of modes

(See Siegel, 1956, pp.202-213)

Table A5.6 sets out the distribution of rho values for all possible arrangements when four, five and six modes are evaluated. Table A5.7 lists the specific rank order patterns that generate selected rank order correlation coefficients.

TABLE A5.6 Distribution of Rank Order Correlation Coefficients for All Possible Ranking Patterns

Rank Order Correlation Coefficient	Number of Modes Ranked		
	Four	Five	Six
-1.00 to -0.81	4	8	21
-0.80 to -0.61	1	13	66
-0.60 to -0.41	0	6	64
-0.40 to -0.21	4	14	86
-0.20 to -0.01	2	16	123
0.00 to +0.19	4	22	123
+0.20 to +0.39	4	14	86
+0.40 to +0.59	0	6	64
+0.60 to +0.79	1	13	66
+0.80 to +0.99	3	7	20
+1.00	1	1	1
Total	24	120	720

TABLE A5.7 Ranking Patterns for Selected Rank Order Correlation Coefficients

The table lists the ranking patterns that generate selected rank order correlation coefficients when compared with the pattern 123456.

rank order correlation coefficient

ρ=0.943	ρ=0.886	ρ=0.829	ρ=0.771	ρ=0.714	ρ=0.657	ρ=0.600	ρ=0.543	ρ=0.486
123465	124365	123564	123654	124635	124563	124653	125634	125643
123546	132465	123645	125436	125364	126345	125463	134625	126453
124356	132546	124536	132564	132654	134526	126354	136245	126534
132456	213465	125346	132645	135246	152346	126435	142563	136254
213456	213546	134256	134265	142536	214635	135264	145236	143625
	214356	142356	142365	143265	215364	135426	152364	145326
		214365	143256	215436	231564	142635	214653	153264
		231456	213564	241356	231645	143526	215463	153426
		312456	213645	314256	234156	152436	216354	154236
			213654	321465	241365	153246	216435	215634
			214536	321546	312564	214563	235146	241635
			215346		312645	216345	243165	251436
			231465		314265	231654	251346	315264
			231546		412356	234165	314526	315426
			312465			241536	321654	325146
			312546			243156	324165	241265
			321456			312654	341256	342156
						315246	412536	421536
						321564	413265	423156
						321645	421365	431256
						324156		
						412365		
						413256		
						421356		

Appendix 5d: Attribute Importance : Ratings and Weights

Attribute importance ratings were recorded for each respondent to the Mode Image Survey in an attempt to take account of the fact that, in making a choice, decision-makers give more attention to certain attributes of the alternatives than to others. A five-point scale of importance was used to collect the ratings. Table A5.8 identifies the various response patterns generated by this scale.

Incorporation of the attribute importance ratings into the choice model was accomplished by means of a system of numerical weights which inflated or deflated the contribution of a particular mode image value to the total mode score according to the importance rating given to that attribute. A standard set of weights (1.0, 2.0, 3.0, 4.0, 5.0) was used for all of the models examined in Chapter Six. For comparison, Table A5.9 presents the results obtained from the Basic Model for a selection of alternative sets of numerical weights.

TABLE A5.8 Attribute Importance Ratings: Pattern of Use

Rating Pattern[a]	Frequency	Percentage Frequency
1, 2, 3, 4, 5	69	28.3
1, 2, 3, 4	85	34.8
1, 2, 3	46	18.9
1, 2	8	3.2
1	1	0.4
1, 2, 3, , 5	13	5.3
1, 2, , 4, 5	4	1.6
1, 2, , , 5	2	0.8
1, 2, , 4	7	2.9
1, , 3	1	0.4
, 2, 3, 4, 5	2	0.8
, 2, 3, 4	5	2.0
, 2, 3	1	0.4
All Patterns	244	99.8

a. The patterns show that a particular rating was used but do not indicate how the 19 ratings reported by each respondent were distributed within the pattern. The key to the rating patterns and the overall frequency with which individual ratings were used is given below.

	Total Frequency	Percentage Frequency[b]
1 - Very Important	1502	32.4
2 - Quite Important	1887	40.7
3 - Neither Important nor Unimportant	729	15.7
4 - Quite Unimportant	366	7.9
5 - Very Unimportant	152	3.3
	4636	100.0

b. Note that if the ratings had been spread evenly over the 5 categories each of these values would be 20.0.

TABLE A5.9 Some Alternative Sets of Numerical Weights[a]

Weight Set[b]					Mean Rho	Standard Deviation	Perfect[c]	Matches[d]
1.0,	2.0,	3.0,	4.0,	5.0[e]	0.491	0.500	1.2	40.9
1.0,	1.0,	1.0,	1.0,	1.0[f]	0.503	0.500	2.9	42.6
2.0,	3.0,	4.0,	5.0,	6.0	0.504	0.500	1.2	42.2
3.0,	4.0,	5.0,	6.0,	7.0	0.504	0.500	1.6	42.2
1.0,	3.0,	5.0,	7.0,	9.0	0.480	0.500	1.2	40.5
0.1,	0.2,	0.3,	0.4,	0.5	0.489	0.500	1.2	40.9
0.5,	1.0,	1.5,	2.0,	2.5	0.491	0.500	1.2	40.9
1.5,	2.0,	2.5,	3.0,	3.5	0.504	0.500	1.6	42.2
2.0,	2.5,	3.0,	3.5,	4.0	0.506	0.500	1.6	41.8
2.5,	3.0,	3.5,	4.0,	4.5	0.504	0.500	2.0	42.2
3.0,	3.5,	4.0,	4.5,	5.0	0.504	0.500	2.9	41.8
3.5,	4.0,	4.5,	5.0,	5.5	0.506	0.500	2.5	41.8
3.75,	4.0,	4.25,	4.5,	4.75	0.504	0.500	2.5	42.6
4.0,	4.5,	5.0,	5.5,	6.0	0.506	0.500	2.5	41.8
4.5,	5.0,	5.5,	6.0,	6.5	0.507	0.500	2.5	41.8
5.0,	5.5,	6.0,	6.5,	7.0	0.508	0.500	2.5	42.2
5.5,	6.0,	6.5,	7.0,	7.5	0.508	0.500	2.5	42.2
6.0,	6.5,	7.0,	7.5,	8.0	0.508	0.500	2.5	42.2
6.5,	7.0,	7.5,	8.0,	8.5	0.505	0.500	2.5	42.6
1.0,	1.0,	1.0,	1.0,	0.0[g]	0.509	0.500	2.9	43.9
1.0,	1.0,	1.0,	0.0,	0.0[g]	0.513	0.500	1.6	43.0
1.0,	1.0,	0.0,	0.0,	0.0[g]	0.515	0.500	1.2	44.3
1.0,	0.0,	0.0,	0.0,	0.0[g]	0.381	0.487	0.0	34.0
0.0,	1.0,	0.0,	0.0,	0.0[g]	0.485	0.502	2.0	40.2
0.0,	0.0,	1.0,	0.0,	0.0[g]	0.369	0.483	0.0	22.5

a. These results were obtained from the Basic Model (Model II) using all 19 scales for which attribute importance ratings were available and covering the full six modes.

b. The weights listed were used for the importance ratings: Very Important, Quite Important, Neither Important Nor Unimportant, Quite Unimportant and Very Unimportant respectively.

c. Perfect: the proportion of respondents that obtained a perfect prediction.

d. Matches: the proportion of respondents that achieved a match between the first predicted mode and the first preference.

e. This is the "standard" weight set used in all of the models discussed in Chapter Six.

f. The results obtained from this weight set are equivalent to those obtained from the Primary Model (Model I) except they exclude the effect of the "Safety" and "Relaxation" scales.

g. These results indicate the effect of removing from the model those scales with particular importance ratings. This effect was achieved by setting the appropriate weights to 0.0.

Appendix 6: Interpretation of the Mode-Choice Reasons and Mode Disadvantages Categories

Appendix 6a : Mode-Choice Reasons

Appendix 6b : Mode Disadvantages

Appendix 6a: Interpretation of the Mode-Choice Reasons

This appendix presents examples of the range of responses included within each of the mode-choice reasons "super-categories". The number in parentheses after each heading indicates the total frequency of mention for that reason.

Cost (249)	cheap; economical; reasonable cost; cheaper than plane; have a car allowance; cheaper for a group; paid by government; my company pays; costs about the same as bus; not much more expensive than others.
Travel Time (150)	quicker; saves time; long, slow train journey; arrive within one day; doesn't stop at many stations; less delay than aeroplane; there and back in one day.
Flexibility (142)	travel in own time; easy to stop anywhere; independence; make stops in out of the way places; can arrive at the right time; transport available at destination; door to door travel.
Convenience (137)	convenience; easy; simple; more convenient than train or taxi; plane not convenient.
Safety (112)	safety; safer than taxi; rarely has accidents; skilful, careful drivers; safe travel night and day.
Speed (100)	speed; fast; express service; faster than private car.
Comfortable Seats (81)	comfortable; comfortable seats; more comfortable than car; bus uncomfortable.
Relaxing (71)	less tiring; can relax; no disturbance while travelling; not boring; relaxing; can take a break every so often; can think and read; not as tiring as car.
Preference (41)	like driving; good satisfying service; pleasant; usual mode; like flying; best methods; fed up with air; preference via experience.

<u>Scenery</u> (39)	can see the countryside; to familiarise with the route; different return route from train.
<u>Own Vehicle</u> (32)	own a car; do not own a car; who would look after it at home?; car is essential for my work.
<u>En-route Facilities</u> (30)	refreshment facilities; meal and drink stops; toilet facilities; trains have sleeping facilities; berths comfortable and clean.
<u>Timetable</u> (28)	can travel by night; infrequent bus service; available any time; timetable convenient; good departure time.
<u>Spacious</u> (24)	spacious; freedom of movement; can stretch legs; spacious, wide seats.
<u>Miscellaneous</u> (19)	taking car for repairs; chance to run car in; car ferrying is my job; no worries about disembarking; safe, no theft; to try out the railways; for the experience; a change from train.
<u>Travel in a Group</u> (17)	convenient with family; business associates can travel together; can hang a cradle for the baby; can take people.
<u>Access to Mode</u> (15)	time wasted going to the airport; easy to get to bus stop; house is near the station; air terminal is remote.
<u>Taking Luggage</u> (13)	easy to carry luggage; can carry luggage without cost.
<u>No other possible</u> (13)	other transport unsuitable; no other means available; buses all booked; left car to son; no choice.
<u>Cleanliness</u> (11)	clean; keep fresh ready for work; not so much soot; nobody spitting; train dirty.
<u>Decision by Others</u> (10)	planned for me; part of a much longer tour; suggested by elders.
<u>Meet People</u> (10)	meet new people; don't feel lonely; people are friendly; travel with ordinary people.
<u>Seat Reservations</u> (9)	no rush for seats; seats are numbered; can book seat early.
<u>Not Crowded</u> (9)	not crowded; only four people; train is crowded; many seats available.

Fixed Schedule (8)	fixed schedule; can plan time of start; arrival time is known.
Ventilation (7)	airy; air conditioned; cooler at night.
Suitable Distance (7)	convenient for the distance; good for a long journey.
Reliability (7)	reliable, trustworthy; car too old and unreliable; road travel unreliable because of floods.
Personal Service (6)	well looked after; pleasing personnel; service pleasing.
Road Quality (5)	good roads.
Waiting (5)	no waiting on public transport; short time to wait.
Social Status (5)	prestige; to keep with fashionable crowd; normal way for business.
No Worries (3)	no worries; no responsibility required.
Privacy (3)	privacy; can keep to ourselves.
Punctuality (2)	punctual departures and arrivals.
Smooth Ride (2)	less chance for travel sickness.
Information (1)	uncertain of roads.

Appendix 6b: Interpretation of the Mode Disadvantages

Examples of the various responses that were included in each of the mode disadvantages "super-categories" are given in this appendix. The total frequency of mention for each disadvantage is given in parentheses after the heading.

Safety (202)	dangerous; too fast at times; careless drivers; heavy vehicles speeding; vehicles travel too close; roads slippery when wet; cyclists and bullock carts in the way; lorries and buses overtaking; dangerous bends; discourteous drivers.
En-route Facilities (146)	expensive refreshments; water finished; refreshment stops too short; electric wires interfere with radio; lack of wayside toilet facilities; no reading material; toilets are dirty; no entertainment; no bank at airport; no first aid equipment; poor food.
Travel Time (130)	long time; delays because of the ferry; customs checks; speed limits in towns; too many long stops; unscheduled delays; roads congested; road works cause delays; other drivers are too slow.
Rough Ride (76)	travel sickness in bad weather; coaches sway too much; track quality is poor; bumpy ride on rough roads; air pockets; suspension too hard.
Waiting (70)	time waiting at airport; check-in time; time to collect baggage; taxis wait too long for passengers; poor scheduling of connections; flight delays.
Heat (65)	hot; no air conditioning; poor ventilation; air conditioning not working properly; too cold inside.
Cost (48)	expensive; petrol tax too high; more expensive than bus; toll unnecessary; taxis increase fares during festivals; expensive if alone.
Tiring (47)	tiring; boring; tired driving alone; cannot rest.
Access (45)	time lost in travelling to airport; distance to airport; poor airport to

	town transport; parking difficulties in towns; some drivers refuse to take you home; stations far from town.
Comfortable Seats (38)	seats uncomfortable; no headrest; need adjustable seats; seats small and uncomfortable; seats have no armrest.
Cleanliness (38)	fumes from lorries and buses; dirty seats; bus getting dirty; passengers smoke.
Personal Service (35)	ticket inspectors are rude; unco-operative drivers; staff irresponsible; rude cabin staff; not informed of delays; poor supervision - bag stolen.
Crowded (32)	too crowded; no seats left during holidays; sometimes overloaded.
Road Quality (27)	narrow roads; poor road camber; narrow bridges; wooden bridges.
Slow (26)	slow; slower than taxi; slower than bus.
Reliability (26)	possible mechanical fault; uncertainty; poor maintenance; possibility of puncture; might overfly.
Cramped (21)	can't stretch legs because of luggage; space restricted; discomfort because seated so long; insufficient leg room.
Seat Reservations (20)	tickets should be numbered; not guaranteed a seat; third class rush for seats; difficult to get reservations; have to reserve early.
Timetable (19)	sometimes inconvenient schedule; limited timetable; leaves too early; infrequent departures.
No Disadvantages (18)	no disadvantages.
Noise (17)	noisy, can't sleep; undesirable, talkative neighbours; noisy engine; better if less talk.
Vehicle Condition (17)	too old; third class needs improvements; lights not good enough; need better curtains; windows in poor repair.
Taking Luggage (17)	not enough room for luggage; need special place for luggage; cannot take much luggage.

Poor Information (14)	poor highway signs; hard to find out what is going on.
Worries (10)	driving responsibility; driving in a storm; nerve wracking.
Cannot see scenery (8)	cannot look out windows; don't see much scenery.
Punctuality (7)	doesn't keep to schedule; sometimes late.
Weather Protection (5)	get wet.
Miscellaneous (5)	immigration procedures; no choice of airline; not very satisfied.
Lack of Privacy (3)	interference from hawkers; don't let beggars on.
Fixed Schedule (2)	fixed schedule.
Inconvenient (2)	inconvenient.
No Fixed Schedule (1)	no fixed schedule.
Inflexible (1)	won't stop where I want.
Loneliness (1)	loneliness.

Appendix 7: Ecological Clustering in Cognitions and Decision Processes: Summary Tables

This appendix presents the summary tables used in the analysis of ecological clustering in cognitions and decision processes. Tables A7.1 and A7.2 report on the analyses drawn from the In-transit Survey and Mode Image Survey respectively. Table A7.3 summarises the equivalent results drawn from selected AID analyses of the choice models.

TABLE A7.1 Ecological Clustering in Cognitions and Decision Processes: In-transit Survey

Variables	Possible Modes[a]	Practicable Modes[a]	Impracticable Modes[a]	Mode-Choice Reasons[a]	Mode Disadvantages[a]	All Measures[b]
Personal Characteristics						
Sex	10=	16=	16	8=	14	13
Age	10=	19=	20	19=	16	15
Income	10=	7	6=	12	12	7
Occupation	10=	13=	12=	18	17	14
Ethnic Group	7=	12=	17=	8=	4=	8
Car Ownership	4=	2	2	2	3	1
Motorcycle Ownership	10=	6	10=	14=	10	9
Travel Experience						
Travel Mode Experience	10=	13=	14=	13	9	11
Total Travel Experience	10=	13=	14=	10=	13	12
Travel by Air	10=	8=	6=	4	2	4
Travel by Bus	10=	19=	17=	19=	20	16=
Travel by Car	10=	16=	9	7	11	10
Travel by Motorcycle	1	1	1	-	-	-
Travel by Taxi	10=	22	23	21	21=	18
Travel by Train	10=	23	22	19=	18	17
Survey Trip Situation						
Travel Mode	4=	4	4	1	1	2
Travel Route	4=	11	12=	5	4=	5
Trip Purpose	2=	5	3	6	6	3
Trip Payment	10=	10	6=	10=	8	6
Train Class[d]	2=	3	5	3	15	-
Sleeper[d]	7=	16=	10=	14=	7	-
Air Class[e]	10=	8=	17=	-	-	-
Size of Travel Group	10=	21	21	14=	19	16=
Mode-Choice Context						
Practicable Modes Code	-	-	-	17	21=	-

a. The numbers in each column indicate how the variables ranked in terms of the degree of relationship with the given cognition-decision measure. Rank 1 identifies the strongest relationship and rank 21 the weakest. This table is derived from Tables 3.6, 3.13, 3.17, 4.5 and 4.13. The variables are defined in Table 3.5.

b. The variables were ranked according to the sum of the ranks in the other five columns. Rank 1 identifies the most powerful variable overall and rank 17 the weakest. Four variables have been excluded from this list because
(a) they were measured for fewer than the full 499 respondents or
(b) a valid calculation of Cramer's V^2 could not be obtained.

c. Only 16 respondents.

d. Only 114 respondents.

e. Only 110 respondents.

TABLE A7.2: Ecological Clustering in Cognitions and Decision Processes: Mode Image Survey

Variables	Mode Images: Air[a]	Bus[a]	Car[a]	Motorcycle[a]	Taxi[a]	Train[a]	Mode Preference Rankings	Attribute Importance Ratings	All Measures[b]
Personal Characteristics									
Sex	11	11	13	12	13	11	15	17	17
Age	2	4	4	2	2	2	2	2	2
Income	3	1	3	3	4	4	3=	3	3
Occupation	4	2	2	4	3	3	8	10	4
Occupation[c]	1	3	1	1	1	1	1	1	1
Ethnic Group	5	5	7	5	5	7	10	6	6
Ethnic Group[d]	7	10	11	7	9	12	14	7	11
Car Ownership	10	9	10	11	10	10	11	18	14
Motorcycle Ownership	12	13	12	8	7	9	7	19	12
Travel Experience									
Total Travel Experience	6	7	8	6	8	5	17	14	9
Travel by Air	9						19	16	19
Travel by Bus		6					12	9	10
Travel by Car			6				6	4	5
Travel by Motorcycle				9			3=	8	7
Travel by Taxi					12		9	13	15
Travel by Train						6	16	11	13
Nature of Trip									
Trip Type	13	14	14	14	14	14	5	5	16
Trip Destination	8	8	5	10	6	8	13	12	8
Trip Destination[g]	14	12	9	13	11	13	18	15	18

a. The numbers in each column indicate how the variables ranked in terms of the degree of relationship with the given cognition-decision measure. Rank 1 identifies the strongest relationship and rank 14 (or 19) the weakest. This table is derived from Tables 5.11, 5.12, 5.13, 5.14, 5.15, 5.16, 6.4 and 6.9. Tables 3.5 and 5.11 define the variables.
b. The variables were ranked according to the mean of the ranks in the other eight columns. Rank 1 identifies the most powerful variable overall and rank 19 the weakest.
c. As the occupation coded for a student was that of his father or guardian the reported results could be misleading. The analysis was therefore repeated with each respondent grouped according to his "place of employment".
d. Analysis was repeated to exclude the heterogeneous "Other" group.
e. For the mode image measures the analysis was carried out only for travel experience on the same mode. It did not seem reasonable to expect, for example, that travel experience by air could logically affect mode images of train.
f. Note that, in the Mode Image Survey the Trip Type and Trip Destination were defined only after the mode image section of the questionnaire had been completed.
g. Analysis was repeated to exclude respondents resident outside Selangor.

TABLE A7.3 <u>Ecological Clustering in Cognitions and Decision Processes: Mode-Choice Models</u>

Variables	Primary Model (Rho)[a]	Primary Model (Match)[a]	Basic Model (Rho)[a]	Basic Model (Match)[a]	All Measures[b]
Personal Characteristics					
Sex	20=	7	21=	12=	16=
Age	23	22	17=	21	23
Income	12=	5	8	5	7
Occupation	5	4	5=	4	4
Occupation[c]	17	13=	17=	9	14=
Ethnic Group	14	13=	13	12=	9=
Car Ownership	15	16=	15	10	14=
Motorcycle Ownership	18=	19=	21=	17=	22
Travel Experience					
Total Travel Experience	20=	8=	20	17=	20
Travel by Air	18=	15	16	12=	18
Travel by Bus	10=	12	14	11	11
Travel by Car	8=	6	9=	6	6
Travel by Motorcycle	8=	23	11=	22=	19
Travel by Taxi	12=	10=	9=	15=	9=
Travel by Train	16	19=	17=	8	16=
Mode Preference					
Preference : Air	1	16=	1	7	5
Preference : Bus	2	3	2	3	2
Preference : Car	4	1	3	1	1
Preference : Motorcycle	3	8	5=	17=	8
Preference : Taxi	6=	19=	7	17=	12
Preference : Train	6=	2	4	2	3
Trip Nature					
Trip Type	10=	16=	11=	15=	13
Trip Destination	20=	10=	21=	22=	21

a. The numbers in each column indicate how the variables ranked in terms of the degree of relationship with the given measure of how well the choice model reproduced individual mode preference rankings. Rank 1 identifies the strongest relationship and rank 23 the weakest. Only two of the six choice models are examined here: the Primary Model (Model I) and the Basic Model (Model II). This table is derived from the first stages of AID analyses reported in Tables 6.19, 6.20 and 6.21. Tables 3.5 and 5.11 define the variables.

b. The variables were ranked according to the sum of the ranks in the other four columns. Rank 1 identifies the most powerful variable overall and rank 23 the weakest.

c. As the occupation coded for a student was that of his father or guardian the reported results could be misleading. The analysis was therefore repeated with each respondent grouped according to his "place of employment".

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